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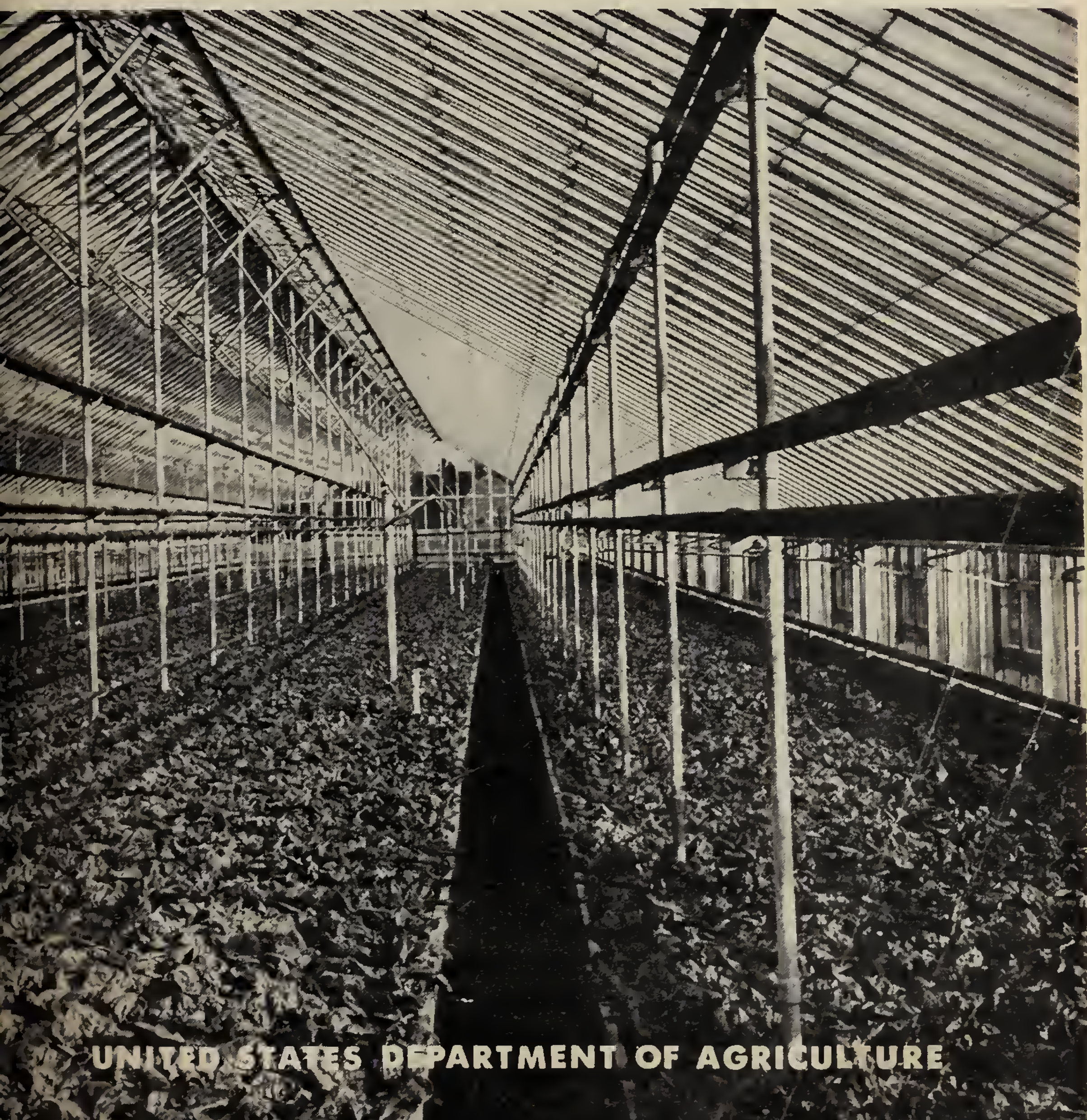
Growing Lettuce In Greenhouses



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Growing Lettuce In Greenhouses

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Growing lettuce under glass is one of the oldest vegetable-forcing industries. Lettuce is well adapted for forcing during the colder months of the year, when light and temperature are less favorable for other vegetable-forcing crops. Much lettuce was grown in hotbeds and coldframes before greenhouses were generally used for growing vegetables. Some lettuce is still grown in frames in early spring and late fall, when only limited protection from cold is required. However, most of the forced crop is now grown in greenhouses especially designed for growing vegetables, and therefore the market can be supplied with fresh lettuce throughout the winter, when the weather is too cold for growing crops in frames.

With the expansion of the field-grown lettuce industry into regions with mild winters, the demand for greenhouse-grown lettuce has gradually declined. Although field-grown head lettuce can now be obtained in most markets the year round, there is still a demand for high-quality greenhouse-grown lettuce during the winter. Growing lettuce under glass still constitutes a sizable industry in certain districts, where its production has become highly specialized and the winter market has been well organized and maintained. The industry has now become fairly well stabilized. It centers around Grand Rapids, Mich., Rochester, N. Y., Ashtabula, Cleveland, and Toledo, Ohio, and Boston, Mass.

Growing lettuce in greenhouses is an expensive and highly specialized business, and it should not be undertaken commercially without practical knowledge in the growing and marketing of the crop.

LOCATION AND CONSTRUCTION OF GREENHOUSES

Since many growers of greenhouse lettuce also plant other crops, they should consider the requirements of these crops in planning the construction of new greenhouses. Lettuce, tomatoes, and cucumbers are the important vegetable-forcing crops, and many growers plant all three at different seasons. Since lettuce is grown chiefly during the winter, when the days are short and there are many hours of dull, cloudy weather, it is important that greenhouses be constructed so as to afford the maximum of light. It is important that the tempera-

[1] Retired July 31, 1958.

ture be properly controlled and that drafts be reduced to the minimum consistent with good ventilation. Efficient heating equipment is essential.

Some important points to be considered in selecting a location for a vegetable-forcing greenhouse include (1) nearness to market, (2) availability and cost of labor, (3) supply and cost of fuel, (4) soil suitable for the crops to be grown, (5) water supply, and (6) freedom from smoke and fumes from industrial plants.

The type of lettuce grown in greenhouses is not so well adapted for long-distance shipment as the hard-headed type grown in the field. It tends to wilt quickly unless it is kept moist and cool. The delicacy of the product makes it imperative that the crops be grown fairly near the market.

Labor is a major item in the cost of almost all commodities, agricultural as well as industrial. Capable, well-trained help is often difficult to obtain. The available labor supply should be kept in mind in selecting a location for a vegetable greenhouse.

The cost of fuel has always been a large item of expense in greenhouse maintenance, and it has risen sharply in recent years. Soft coal has been the chief source of fuel for greenhouse heating, but oil and gas have replaced it to some extent.

Although the soil used in greenhouses can be made to suit the crop to be grown by adding fertilizer, organic matter, lime, and other soil amendments, it is highly desirable that the range be located where the soil is naturally suitable for the crops to be grown. The lighter types of soil are preferred for greenhouse-vegetable production.

There should be an adequate and constant supply of water free of materials that may be toxic to plants or that may corrode the heating system. Highly chlorinated water is not desirable. Avoid a high concentration of salts.

Smoke from industrial plants reduces light intensity through its presence in the air and forms a film on the glass, which greatly reduces the intensity of the light that reaches the plants. Avoid reducing the light of dull winter days by smoke or fumes. Do not locate greenhouses near industrial plants because of the smoke and also the fumes, which may be toxic to certain plants.

Most of the newer greenhouses built for growing lettuce are even-span structures of steel, aluminum, or steel and aluminum. Wood is used much less than in the past. Although the original cost of wood construction may be low, the upkeep in painting, glazing, and other repairs over a period of years adds greatly to the total cost.

Lettuce can be grown in almost any type of greenhouse in which the lighting is good, except the lean-to type, which is not suitable for commercial lettuce growing.

The ridge-and-furrow type of construction (fig. 1) is widely used to enclose a large area under one roof. This kind of structure permits an almost unlimited area to be enclosed with a minimum of obstruction to interfere with cultural operations and the entrance of light.

Large even-span metal-frame greenhouses (fig. 2) are being widely used for vegetable forcing. The use of steel and aluminum in the framework adds greatly to the strength and life of these greenhouses, and they afford better lighting than the old-style wood-frame buildings.

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FIGURE 1.—Ridge-and-furrow type of greenhouse, which permits enclosure of very large areas under one roof.

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FIGURE 2.—Steel-frame greenhouse, ideal for vegetable forcing.

Most greenhouse lettuce is grown on ground beds. In large ranges the entire floor of the greenhouse is fertilized, plowed, and tilled in much the same manner as a field.

LETTUCE VARIETIES FOR FORCING

Of the many lettuce varieties, only a few are suitable for forcing. In the past numerous varieties of head, Cos, and leaf lettuce were grown under glass, but now two or three constitute almost the entire commercial crop.

Only in the Boston district is head lettuce forced in quantity. In the past Belmont, May King, Big Boston, and Salamander were grown under glass with varying success.

Bel-May is a small butterhead variety of lettuce (fig. 3, *A*) developed by the Massachusetts Agricultural Experiment Station. It is still the important greenhouse variety in the Boston market-garden district, but it is not grown in other districts.

None of the crisp head varieties of lettuce are well adapted for growing in greenhouses. Paris White, Trianon, Bath, Express, and other

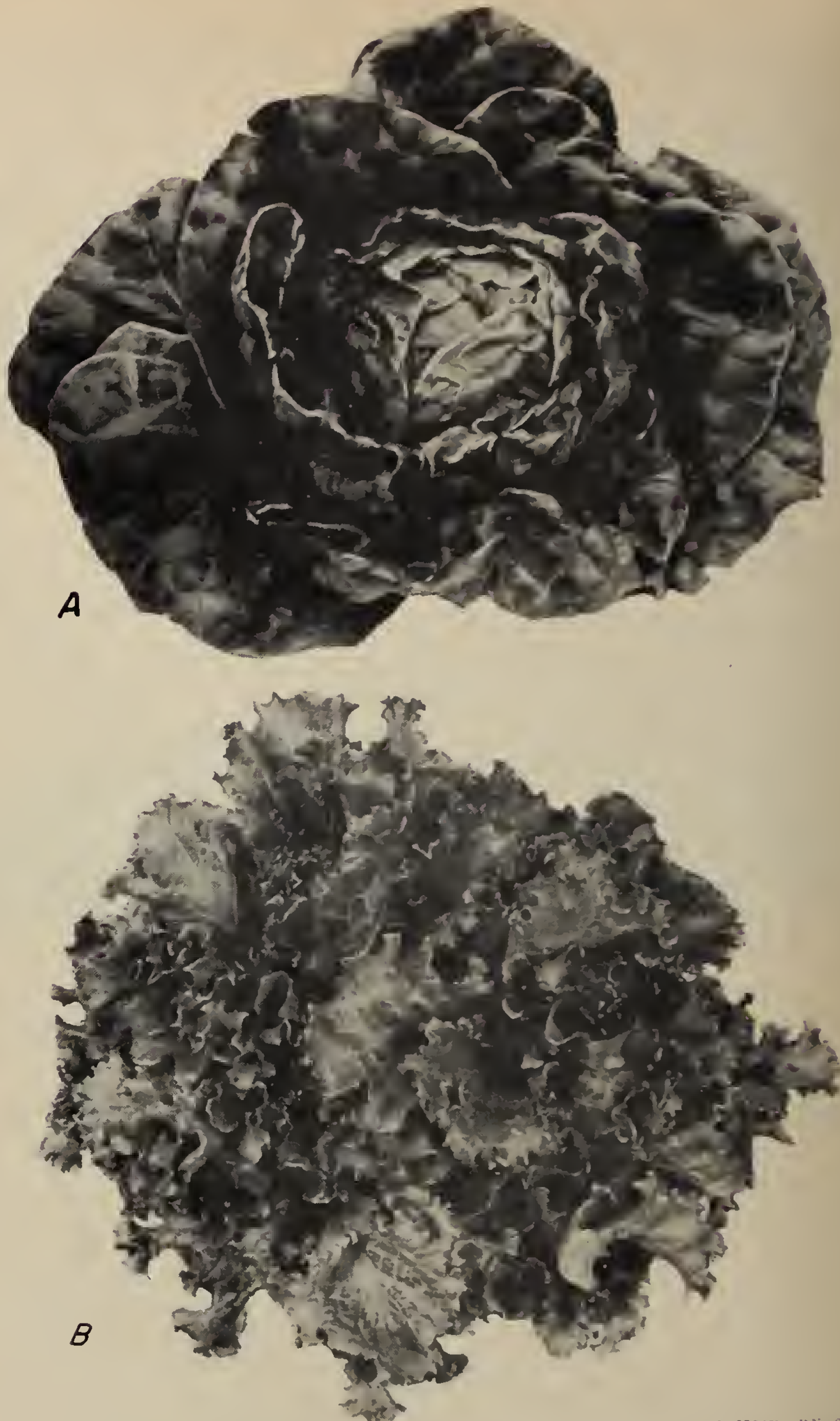

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FIGURE 3.—The two most important varieties of lettuce grown under glass: *A*, Bel-May, a small butterhead variety; *B*, Grand Rapids, a leaf, or nonheading, variety.

varieties of Cos lettuce have at times been grown as forcing crops but with limited success.

Of all the types of lettuce, the leaf variety Grand Rapids (fig. 3, *B*) is the most popular, and it is also the most important greenhouse forcing variety. There are several strains of Grand Rapids, each adapted to particular locations and growing conditions. The Washington strain, sometimes called Grand Rapids Forcing, was developed by the United States Department of Agriculture. It is very popular with the Grand Rapids, Mich., growers. A forcing strain of Grand Rapids that is resistant to tipburn was developed by the Ohio Agricultural Experiment Station. Sometimes known as Resistant Grand Rapids, it appears a few days earlier than the other strains. A third one, Grand Rapids U. S. No. 1, also developed by the Department, is an important strain in New York and other districts where lettuce is forced. It is slower to bolt than the other Grand Rapids strains.

PRODUCTION AND CARE OF SEED

Only those lettuce varieties that are known to be adapted for forcing should be grown under glass. High-quality seed of a good strain is even more important for the forcing industry than for field production. The supply of such seed is often limited, and therefore many large growers have found it profitable to produce their own seed.

By carefully selecting the most desirable plants for seed production, a strain can be developed that is especially adapted to local conditions and resistant to certain diseases. In working for disease resistance, selection should be made under conditions favorable for disease and where disease is present. A pound of seed will be produced from 50 to 75 well-grown lettuce plants. Lettuce averages about 350,000 seeds per pound. The seed of Grand Rapids is small and well below the average in size. A pound of high-quality lettuce seed, if properly handled, will produce enough plants to set an acre.

Plants selected for seed production should be transplanted from the beds to some part of the greenhouse where they can be given special attention (fig. 4). Do not save seed plants that are even slightly off-type lest the strain deteriorate. Unless the greenhouse is screened and all insects are kept out, cover each plant with a light-weight muslin bag just before the first flowers open. Keep the coverings on until all flowers have set seed. If the bags are left on until the seed is mature, the plants can be cut and left in the bags until seed-cleaning time.

After a desirable strain has been isolated, it need not be increased every year. Enough seed for 2 or 3 years can be grown and kept until used if it is stored in a cool, thoroughly dry place. Lettuce seed loses its viability rapidly under humid conditions.

ROTATION AND INTERCROPPING

Growing lettuce in greenhouses should be considered in relation to growing other forcing crops. Very few growers produce a single crop throughout the year. At least part of the year most of them grow other vegetables, such as tomatoes or cucumbers, or some kind of flowering plant.

FIGURE 4.—A crop of Grand Rapids lettuce seed nearing maturity in a greenhouse.

Since lettuce is the only one of the three important vegetable-forcing crops that thrives during the short, dull days of winter, growers usually plan to have it occupy the greenhouse during this period. A crop of tomatoes is often followed by a crop of lettuce, which is followed by a spring crop of tomatoes or cucumbers. Two or three crops of lettuce sometimes follow a fall crop of tomatoes. If cucumbers are used in the rotation, they are usually grown as a spring crop, when light and temperature are more favorable than during the fall and winter months. Rotation plans in common use in large ranges are given in table 1. If it is desired that lettuce be available for cutting continuously for an indefinite period, plantings should be made on several successive dates, so that only part of the crop will reach cutting size at one time.

TABLE 1.—*Greenhouse crop rotations, with planting and harvesting dates*

Plan and crop	Seed sown	Plants set	Crop harvested
Plan 1:			
Tomatoes	July 1–15	Aug. 15–30	Dec. 15–31
Lettuce	Nov. 15–30	Dec. 15–31	Mar. 15–31
Cucumbers	Feb. 1–15	Apr. 1–15	July 1–31
Plan 2:			
Tomatoes	July 1–15	Aug. 15–31	Dec. 15–31
Lettuce	Nov. 15–30	Dec. 15–31	Mar. 15–31
Do	Feb. 1–28	Mar. 15–31	June 1–15
Plan 3:			
Lettuce	Aug. 1–15	Sept. 1–15	Nov. 15–30
Do	Oct. 15–30	Nov. 15–30	Feb. 1–28
Tomatoes	Jan. 1–15	Mar. 1–15	Before Aug. 1

FIGURE 5.—Leaf lettuce intercropped with cucumbers. The lettuce is to be harvested before the cucumber vines begin to run.

In plan 1, the time between the removal of the cucumbers and the planting of tomatoes may be used for soil sterilization. In plan 2, it is possible to grow a third crop of lettuce in part of the space. Growers who follow this cropping plan usually count on 2½ crops of lettuce.

Since leaf lettuce can be grown to salable size in about 8 weeks from the transplanting date, it is often planted between rows of tomatoes or cucumbers (fig. 5) and is harvested before the tomatoes or cucumbers reach such size as to interfere too much with its growth.

Intercropping of lettuce presents difficulties, and the product is usually not of the highest quality. Since cucumbers and tomatoes both require temperatures too high for lettuce, either lettuce or the crop it is grown with is likely to suffer from improper temperature. The shading effect of tall-growing tomatoes and cucumbers where the vines are trained on trellises makes growing conditions unfavorable for lettuce. In general, intercropping tomatoes or cucumbers with lettuce is not a good practice.

GREENHOUSE SOIL AND ITS MANAGEMENT

Growing lettuce and other vegetable-forcing crops in greenhouses is an intensive and expensive operation. Maximum production must be reached quickly and maintained continuously. Most ordinary field soils are not suitable and often require large amounts of organic matter, fertilizer, and lime. Sometimes sand or ashes are added to change the texture and physical properties and thus to make the soil better suited for intensive crop production. Few field soils are ideal for greenhouse-vegetable growing. If it is possible to select the soil upon which the greenhouses are to be constructed, choose land that will require as little modification as possible.

For greenhouse-vegetable production the soil should be lighter than is generally considered suitable for growing the same crops in the

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field. The lighter soils are favored because (1) they are more easily handled in transplanting, tilling, and sterilizing than heavy soils; (2) their surface dries more quickly, and thus disease is less apt to become established and spread; and (3) they are more easily kept in good physical condition, and since they are less likely to become packed, they afford better aeration.

Where the original soil is too heavy, make it more friable by incorporating sand and well-decomposed organic matter. Muck is ideal for supplying organic matter and making soil more friable. However, muck alone is not suitable for vegetable forcing.

Good drainage is essential. Unless the land selected for the greenhouse site is already well drained, provide proper drainage when the greenhouse is constructed. Tile installed for drainage may also be used for soil sterilization. If underlain by a heavy soil, the tile can be used for subirrigation.

Soil Sterilization

The control of plant pests in the greenhouse is more necessary and sometimes more difficult than in the field. Almost universally greenhouse growers practice soil sterilization to control diseases, insects, nematodes, and other plant pests. Sterilize greenhouse soil at least once a year whenever it can be done with the least interference with crop production. This is usually during the summer, when high temperatures are unfavorable for greenhouse crops.

Most large greenhouse ranges for forcing vegetables are equipped to sterilize with steam, which is the most effective and widely used method of controlling soil-borne plant pests. New greenhouses should be provided with such equipment. The most generally used devices for applying steam in soil sterilization are (1) the inverted pan, (2) perforated iron pipes, and (3) drain tile. The method to be used must be determined largely by the conditions.

The inverted pan is best adapted for porous soils, which offer the least resistance to penetration by steam. The equipment consists of a wooden or metal pan of almost any convenient size. Galvanized sheet iron is more durable and lighter than wood. Convenient-sized pans are 4 to 6 feet by 10 to 12 feet and 6 to 8 inches deep. However, the size and shape of the pans should be determined by the dimensions of the planting beds, the capacity of the boiler, and the means of moving the equipment. Each pan is provided with a pipe connection for attaching the steam hose. The pan is inverted, and the edges are forced into the soil a few inches to prevent the escape of steam. If the steam pressure is high, it may be necessary to add some additional weight to hold the pan in the soil. Some large growers have the pan equipped with wheels and a mechanical device by which the apparatus is lifted and rolled when it is necessary to move the pan (fig. 6).

The perforated-pipe arrangement consists of 4 to 6 perforated iron pipes, 1¼ or 1½ inches in diameter and 20 to 70 feet or more in length, which are fastened to a header pipe, 2 inches in diameter, at spacings of 12 to 18 inches. The header pipe is provided with a connection for attachment to the steam hose. The perforations are usually ⅛ or ¼ inch in diameter and 12 inches apart. The size of the equipment is determined by the size of the greenhouse, boiler capacity, and help

FIGURE 6.—Mechanically movable steam pan being used for sterilizing greenhouse soil. The equipment is lifted by a special hoist and moved to a new location on wheels, which roll on the concrete walks.

available for moving. This equipment is buried to a depth of 6 to 10 inches in the soil, and the entire surface is covered with plastic or a heavy canvas to confine the steam. If two or more sets of equipment are available, one set can be buried and made ready while sterilization is going on in another section. The chief objection to this method of sterilization is the great amount of labor required to bury the pipes.

A variation of this method is known as the rake, or steam-harrow, system. The equipment consists of a framework of metal pipes with tees at intervals of 6 to 8 inches, to which about 6-inch lengths of small iron pipe, usually ½ inch in diameter, are connected. The lower ends of these small pipes are closed by flattening to form wedges. Holes, ⅛ or 3/16 inch in diameter, which are drilled through each pipe just above the wedge, provide openings for the escape of steam. The header pipe is equipped with a connection for attachment to the steam hose. The perforated pipes, or pegs, of this equipment are forced into the soil, and the surface is covered with plastic or a heavy canvas to confine the heat. Where the boiler capacity is sufficient to supply the steam, several of these rakes can be operated continuously by a group of workmen. The rake is especially well suited for small greenhouses and ranges having raised benches.

A drain tile 4 inches in diameter and set about 1½ feet deep in rows 1½ to 2 feet apart can be used for both steam sterilization and subirrigation. However, tile lines may be a source of trouble, because they provide a shelter and breeding place for crickets, roaches, and other pests.

In order to destroy the most resistant plant pests, heat the soil to a depth of several inches to 212° F. for a half hour or more. The time required for the soil to reach this temperature will depend on the amount of steam, soil texture, and type of equipment used. Excessive heating breaks down organic materials and leaves the soil in a poor condition for the growing of plants. Plant growth is more satisfactory when steam-sterilized soil is permitted to lie idle for 3 to 4 weeks before it is used.

Soil Preparation

The best soil for forcing crops is one naturally deep, well drained, and friable. In large ranges where the crop is grown on ground beds, the soil remains in place from year to year. Its productivity is maintained by the addition of manure, or other organic matter and fertilizer, and by sterilization. Animal manure is the best source of organic matter. Apply it at the rate of 1 ton to each 1,500 square feet of surface, or about 30 tons per acre. Because of the increasing scarcity and cost of animal manure, greenhouse growers have had to find substitutes for part of the organic matter and to supplement manure with chemical fertilizers. Muck is a good source of organic matter and can be used as a substitute for manure if supplemented with chemical fertilizer. Experiments show that good results can be obtained with 15 tons per acre of manure plus half a ton per acre of a 3–12–4 fertilizer or other commercial fertilizer having a similar formula.

Except on highly fertile soils already well supplied with phosphorus, lettuce yield generally increases with an application of phosphorus in an available form. Superphosphate is preferred to the less soluble forms of bonemeal and ground rock phosphate. Foliage crops like lettuce use large amounts of nitrogen. However, avoid overfeeding with available forms of nitrogen such as nitrate of soda and sulfate of ammonia. Excessive stimulation with nitrogen causes a rank, succulent growth that is subject to disease. Lettuce does not have a high potassium requirement. However, best results with lettuce are generally obtained when a complete fertilizer supplying nitrogen, phosphorus, and potassium in the proportion of about 1 part of nitrogen, 2 or 3 parts of phosphorus, and 1 part of potassium is used.

When making a heavy application of chemical fertilizer, spread it uniformly and work it thoroughly into the soil before planting. Side dressing with nitrate of soda or sulfate of ammonia after the crop has become established should not exceed about 200 pounds per acre. Continued use of large amounts of nitrate of soda may in time result in toxic residues.

Lettuce is more sensitive to soil reaction than are tomatoes or cucumbers. When tomatoes or cucumbers are grown in rotation with lettuce on the same soil, note especially the requirement of lettuce, which does best on soils that are only slightly acid. If the soil is moderately or very acid, correct the acidity by applying lime. It is usually unsafe to exceed the amount indicated by lime-requirement tests.

Lime may be applied as ground limestone, ground burned limestone, or hydrated lime. Ground burned limestone gives the quickest results; ground limestone is slow in its reaction. About one-half as

much ground burned limestone or about three-fourths as much hydrated lime is required to give the same change in soil reaction as a given quantity of ground limestone. Once the soil in a greenhouse has been brought to the proper condition of acidity, a moderate application once a year as indicated by lime-requirement tests will generally maintain a satisfactory soil reaction. More lime will be required when acid-forming materials like sulfate of ammonia are used in the fertilizer than when base-forming materials are used.

STARTING THE PLANTS

Greenhouse lettuce is usually grown from transplants rather than by seeding in the beds where the crop is to be grown. Enough seedlings for an entire range can be grown in one greenhouse, where uniform growing conditions can be maintained. A large part of the range is thus available for other crops while the lettuce plants are being started.

The seedlings are grown on solid beds or raised benches with or without the use of flats. Better plants can generally be obtained if flats are used, and the plants are more easily handled.

Soil for Seedlings

Use a good grade of composted soil for starting the plants. Prepare the compost pile several months or preferably a year in advance. This prepared soil should be free of large clods, stones, or trashy organic matter. Two parts of field sod to one part of stable manure, preferably horse or cattle manure, makes a good compost. If the soil is acid, add ground limestone to the compost pile to correct the condition. It is generally desirable to add a few pounds of a complete fertilizer high in phosphorus to each ton of compost. A 5–10–5 fertilizer or one having a similar analysis is suitable. Cut down the compost pile and turn once and preferably twice to incorporate the manure thoroughly. The lime and fertilizer can best be added at the first turning.

Large ranges are equipped with soil shredders, through which the compost is passed before it is used for planting. If the prepared compost contains coarse material, pass it through a screen. It is advisable to sterilize all compost used for starting the plants, although this is not always done. An entire range may be infected with a disease that originates in the plant bed or seed flat.

It is important that the soil used for starting the plants be friable enough to fall apart readily and permit the separation of the seedlings with a minimum of root injury. Small plants start off more rapidly after transplanting and are much less subject to injury by soil-borne organisms if the root system is kept intact than if the roots are broken or otherwise injured.

Planting the Seed

Since greenhouse lettuce does not sell well until local field-grown lettuce is off the market, set the fall crop so as to be ready to harvest it soon after the field-grown crop is no longer available. About a month is required to produce plants for setting. Growth is slower

and more time is required to produce the crop during the short days of winter than when the days are brighter and longer. When lettuce is not grown with other crops, plant the seed from August 1 to 15 for a crop to mature the last part of October or early November. In large ranges where several crops are grown during the fall, winter, and spring, planting and harvesting go on continuously and several plantings are necessary.

Drill planting of lettuce seed is preferable: however, the seed may be planted broadcast. Drop the seed at the rate of 8 to 12 per inch in very shallow furrows spaced about 2 inches apart. A suitable planting furrow can be made with the edge of a thin piece of wood such as a lath. Cover the seed to a depth of not more than one-eighth inch with muck or leaf mold mixed with sand. Muck is not a good covering when used alone, as it is too light and tends to be pushed up in a sheet as the seed germinates, and therefore a weak, elongated seedling may result. Muck mixed with sand to add weight makes an ideal cover for lettuce seed. Sometimes burlap or other cloth is substituted for the soil covering, and it is thoroughly wet after being laid to help hold the moisture until the seed germinates. When cloth is used, it is essential to remove it as soon as the seed starts to germinate.

Seed Treatments To Improve Germination

The seed of many lettuce varieties germinates poorly if planted soon after harvest. Such dormant seed requires a month or two of after-ripening in storage under dry conditions before it will germinate well.

Some lettuce seed germinates poorly at temperatures of 75° F. or above, especially the Grand Rapids variety. When the greenhouse temperature can be controlled, keep it at 65° to 70° until the lettuce seedlings have emerged aboveground. Good, viable, nondormant seed will germinate in less than 24 hours at this temperature. At higher temperatures most lettuce seed will require at least 3 to 5 days for emergence, depending somewhat on the depth of covering.

If dormant lettuce seed is to be planted when the greenhouse temperature cannot be held below 75°, germination can be greatly improved by soaking the seed in a ½-percent solution of thiourea for 8 to 10 hours at 65° to 70°. After removal from the solution, the seed may be planted while damp, or it may be scattered thinly on a dry surface until dry and then stored until planting time. The increase in germination due to the thiourea treatment will remain effective for several months if the seed is stored in a cool, dry place. A similar treatment with water alone will aid in the germination of most lettuce seed.

Dormant lettuce seed can be made to germinate more readily if given a cold treatment just before planting. Germination has improved greatly when dormant lettuce seed is soaked in water for 2 or 3 hours and then held at 39° with good aeration for 4 to 6 days. With the cold treatment the seed cannot be dried and stored. It must be planted while moist to benefit from the treatment.

Transplanting

Greenhouse lettuce is usually transplanted, or pricked off, twice, (1) from the planting bed or seed flats to other flats and (2) from

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FIGURE 7.—Plants for a 10-acre range transplanted into flats and placed on a greenhouse bed.

these flats to the beds where the crop will be grown. Transplanting is expensive, but it produces better plants. Do the first transplanting about a week after the seedlings emerge. The interval between emergence and transplanting depends on the growth rate and the thickness of seeding. If the seedlings are close together or the temperature in the greenhouse is high, transplant sooner than if the greenhouse is cool or the plants are not crowded. If vigorous, stocky plants are to be obtained, do not delay transplanting until the seedlings become crowded. The less the roots of the seedlings are broken or injured in lifting from the plant beds or flats, the sooner the plants will recover after transplanting.

The seedlings are sometimes transplanted into small pots or paper bands, but the common practice is to transplant them into standard planting flats (fig. 7). Allow about 2 inches between the plants in the flats. The flats in general use hold 60 to 75 plants at the 2-inch spacing. Experienced workers can transplant as many as 5,000 plants a day. As soon as the plants are set in the flats, water the soil. It is important that the first watering be thorough. Apply enough water to wet the soil to the bottom of the flat. Apply the water as a fine spray so as not to injure the plants by covering the leaves with mud. Be especially careful if the plants are wilted.

ESTABLISHING THE CROP PLANTS

After transplanting the seedlings, leave them in the growing flats or pots until good, sturdy plants have developed but not until they are crowded. Holding too long before the final transplanting results in elongated, bleached plants that are stunted and start off slowly. Planting distances of 7 by 7 inches to 9 by 9 inches are generally used. Some growers plant closer in one direction than in the other to make cultivation easier. Planting in squares allows the plants to develop uniformly. The greater number of plants required for close planting

(table 2) adds to the cost of plants, increases the chances for disease, and may not increase the total yield per unit area enough to justify the practice.

In setting the plants in the greenhouse beds, some kind of marker is essential for spacing the plants accurately. One such device (fig. 8) consists of a broad board with wooden pegs, which are 1½ inches in diameter and about 2 inches long and are attached at the desired planting distances. It speeds the work of setting and assures accurate spacing of the plants. The workers kneel on the board while they are transplanting. As the plants are being set in holes already made by the marker, other holes are being made.

Retain as much soil as possible on the roots in removing the plants from the flats, so that there will be a minimum check in growth. Running a knife through the soil between the plants in both directions

TABLE 2.—*Planting distance and number of lettuce plants required per 1,000 square feet and per acre*

Distance between plants (inches)	Plants for—		Distance between plants (inches)	Plants for—	
	1,000 square feet	1 acre		1,000 square feet	1 acre
	Number	*Number*		*Number*	*Number*
6 by 7	3,429	149,368	7 by 8	2,571	111,993
6 by 8	3,000	130,680	7 by 9	2,286	99,579
6 by 9	2,667	116,175	8 by 8	2,250	98,010
7 by 7	2,939	128,023	8 by 9	2,000	87,120

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FIGURE 8.—Setting lettuce plants in the greenhouse. The board serves as a support for the workers as well as a marker for spacing the plants.

helps to retain the soil around the roots. Too deep setting of lettuce plants is ruinous. It is better to set them a little shallow than too deep. The soil should come almost to the bottom pair of leaves. Leaf petioles and blades are much more subject to decay by soil organisms than stems.

GENERAL CARE OF THE CROP

Watering

Lettuce, which requires a great deal of water, should never be permitted to suffer from want of moisture. Thorough irrigation is much better than frequent light wettings. Frequent wetting of lettuce leaves tends to spread diseases. Moisture favors drop, bottom rot, gray mold, and mildew. The sooner moisture can be dried from the leaves after wetting the better. There is less danger of foliage diseases getting started in lettuce during the early stages before the plants cover the soil and when ventilation and air movement are good. Subirrigation is ideal for lettuce, because moisture can be kept off the leaves.

Overhead irrigation insures more uniform distribution of water, reduces labor costs, and provides less chance for damage to plants than hand-operated nozzles.

Pipelines equipped with sprinkling nozzles spaced about a foot apart are fastened to the supporting parts of the greenhouse. A single line of pipe will handle a 40- to 50-foot width of greenhouse space. By inserting a swinging joint near the valve end, the entire line can be rotated so as to cover all the space between the lines.

Temperature and Ventilation

Lettuce is a cool-season crop and thrives best at fairly low temperatures. High temperatures favor rapid growth, but they increase the chances for disease and may cause weak, spindling plants. Temperatures may be high with less danger to the plants during the early stages of growth than when the plants are larger and air movement between them is reduced. It is important that temperatures be held low as the crop nears maturity.

There should be a difference of 10° to 15° F., and perhaps more, between day and night temperatures; however, sudden changes in temperature should be avoided. The exact temperatures that should be maintained within a greenhouse for growing lettuce must be determined to some extent by the conditions outside, as they affect the amount of ventilation that can be used. After irrigation, when the humidity within the greenhouse is high, it is best to maintain the temperature a few degrees lower than if the foilage were dry and the humidity low. Night temperatures of 45° to 50° and day temperatures 15° higher are satisfactory for lettuce during the winter. However, in early fall and late spring it may be impossible to maintain these optimum temperatures.

Ventilate the lettuce as much as outside conditions will permit. The top vents should never be closed tightly, except during very cold or stormy weather. Stagnant, humid air contributes to the development of some diseases of greenhouse lettuce.

Cultivation

The removal of weeds, which is one of the chief purposes of cultivating crops grown in the open, is generally not a problem in greenhouses. Once the soil in a greenhouse has been steam sterilized, weeds should not be troublesome unless their seeds are introduced in manure and other materials used in preparing the soil. Shallow cultivation to break up the surface crust may be beneficial while the plants are small, especially if the soil contains considerable clay. However, after the plants have begun to cover the soil, cultivation may do more harm than good. Cultivation is usually done with ordinary hand tools. Long-handle tools can be used on narrow beds, but some kind of trestlework on which workmen can stand is desirable for wide beds. If the spacing is wide, wheel hoes may be used for cultivating small plants.

HARVESTING AND MARKETING

The time required to produce a crop of lettuce, from transplanting in the greenhouse beds until harvesting, ranges from 6 to 12 weeks, depending on the market demand as regards plant size and the season of the year. When prices are good, it may be profitable to harvest before the plants reach maximum size even though this means some loss in total yield. When lettuce is sold by weight, growers like to allow the plants to become as large as possible without reduction in quality. A longer time is required to produce plants of marketable size during the short days of winter than during the sunnier, longer days. If another lettuce crop is to follow the one about ready to harvest, the condition of the seedlings for the next crop may make it necessary to harvest earlier than otherwise to avoid damage from holding the seedlings in a crowded condition.

In harvesting, the plants are cut just above the soil surface with a short-blade knife. Sometimes they are trimmed and packed in the greenhouse as they are harvested. However, most large establishments are equipped with washing and packing sheds, and then only the spoiled, dirty outer leaves are removed in the greenhouse. The plants are placed in containers and taken to the shed where they are trimmed, washed, and packed for market (fig. 9).

The washed plants are packed wet, as some moisture is required to keep them fresh in transit. If the bottom of the packing containers is tight, holes should be made to permit the escape of the water that collects at the bottom.

There is no established standard container for packing and shipping greenhouse lettuce. Various kinds of packages, baskets, hampers, boxes, and barrels have been used. Rectangular splint baskets holding about 10 pounds of lettuce are generally used by Ohio growers. Large containers are usually lined with heavy paper. Paper linings afford some protection from freezing when lettuce is shipped in cold weather. The container covers are of paper to prevent wilting of the lettuce before it is placed on the market.

Grades and marketing standards are subject to periodic changes. Information about legal standards can be obtained from the Agricultural Marketing Service, United States Department of Agriculture.

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FIGURE 9.—Harvesting lettuce in bushel baskets for removal to the packing shed, where it is to be trimmed, washed, and packed.

The profit to be expected from a given unit area of greenhouse lettuce depends on many factors—labor, fuel, fertilizer, and other production costs, market demand, quality of the product, and yield. Any estimate of profit that might be expected could only be a rough approximation. About a pound of lettuce per square foot of greenhouse space is considered a good yield. Yield per unit area depends largely on the stage of development at which the crop is harvested. In order to obtain a yield of a pound per square foot of space, the plants must reach near-maximum size before cutting. Market demand and prices may make it more profitable to harvest smaller plants even though the total yield is reduced.

DISEASES AND THEIR CONTROL

Drop

Drop is possibly the most damaging disease of greenhouse lettuce. It is caused by fungi that persist in the soil. The stem is infected at the soil line, after which the leaves progressively wilt and the entire plant eventually collapses. Affected plants show a soft watery rot of the stems and leaves near the soil. The decayed tissues are soon covered with a cottony-white fungus growth, which produces black sclerotia, or seedlike bodies. These are found in or on the decayed leaves and stems, their size depending on the species of fungus present. Sclerotia are resistant to an unfavorable environment and serve to maintain the fungus in the soil.

Drop is particularly apt to cause trouble during damp, cloudy weather. Too high a temperature, improper ventilation, overwatering, and crowding the plants tend to increase losses from the disease. Proper management of the crop, particularly using water sparingly during the 3 or 4 weeks before harvest, helps to check the spread of drop. When the disease appears, remove and destroy affected plants,

including taproots and surrounding soil. This helps to prevent infection of adjacent plants and also the formation of sclerotia. When drop causes severe loss, the best remedy is to sterilize the soil with steam (see p. 8).

Bottom Rot

Bottom rot is destructive in some sections of the country, especially to head lettuce, whose outer leaves rest on the ground. It most frequently occurs as the plants approach maturity. The disease is caused by a soil-borne fungus. Brown spots develop on the midribs and blades of the leaves. This begins at the bottom of the plant and is followed by a brown soft rot that extends into the head. There is a brown fungus growth over the leaves and formation of brown sclerotia.

Excess moisture favors bottom rot, and losses can often be much reduced by using no more water than is essential for satisfactory growth. When this measure is not effective, sterilize the soil with steam (see p. 8).

Gray Mold

Gray mold is caused by a fungus that is most likely to be damaging when plants are weakened by unfavorable growing conditions or by other diseases. It is characterized by a brown soft rot of the leaves, which become covered with a grayish mass of fungus growth. When plants are severely damaged, black sclerotia may be produced.

Gray mold often follows tipburn, as the fungus readily attacks the dead areas caused by tipburn at the leaf margins. Ample ventilation and soil sterilization with steam (see p. 8) help to prevent or delay the development of gray mold.

Downy Mildew

Downy mildew is characterized by yellowish or brownish spots on the outer leaves. The lower surface of the leaves becomes covered with a white fuzzy growth of the causal fungus.

Insufficient ventilation, overwatering, and fluctuating temperatures favor the development of downy mildew. Careful management of the greenhouses, particularly the avoidance of high humidity, is usually effective in controlling this disease.

Anthracnose

Anthracnose, also known as shot hole or rust, is caused by a fungus that produces reddish-brown roughly circular spots on the leaves. The centers of the older spots often drop out and give a shot-hole appearance. On the midribs the spots are narrow and slightly sunken. The fungus lives on infected plant refuse and its spores are water borne.

Low temperatures and overwatering favor this infection, especially when water is applied as a coarse spray that spatters soil on the plants. Plant losses can be reduced by using water sparingly. Apply it as a fine mist, as a slow stream from a hose, or by subirrigation to avoid spattering soil on the leaves.

Rosette

Rosette causes considerable losses of greenhouse lettuce. This disease and bottom rot are caused by the same fungus, which attacks the plants when they are small. Rosette is characterized by a decay of the roots that stunts the plants, especially when they have been badly set, improperly fertilized, or grown on poor soil.

Good growing practices help to reduce loss, but soil sterilization (see p. 8) may be necessary if the disease persists.

Tipburn

Head lettuce and, to a less extent, leaf lettuce are subject to tipburn. This nonparasitic injury causes the margins of the leaves in the central part of the plant to turn brown and die. The dead areas rarely extend more than one-half inch from the edge of the leaf.

Tipburn is most prevalent when temperatures are high and the plants are making a rapid succulent growth. It often occurs after a few cloudy days when the greenhouses are kept at rather high temperatures with inadequate ventilation. Slightly lower temperatures than normal and adequate ventilation will reduce losses from tipburn during the winter. When outside temperatures are high during the fall and spring, care in the use of nitrogenous fertilizers, watering, and ventilating will help to maintain a firm growth of leaves and hold the disease in check.

Root Knot [2]

Root knot has never been considered particularly destructive to greenhouse lettuce, but it must be controlled to obtain the best lettuce yield. During the winter, lettuce greenhouses are usually kept at such a low temperature that the disease remains dormant and does no damage, but during the warmer weather of fall and spring root knot may cause serious injury. It is very injurious to both cucumbers and tomatoes, and when one or both of these vegetables are rotated in the greenhouse, the disease should be controlled.

Steam sterilization of the soil is an effective control measure if done carefully and thoroughly. The microscopic nematode, or eelworm, causing this disease works down to a depth of a foot or more and penetrates under walks and side walls. Satisfactory control cannot be expected unless the soil is heated to at least 212° F. and to a depth of at least a foot.

INSECT PESTS AND THEIR CONTROL

Greenhouse lettuce is subject to injury by a variety of insects and related pests. Those most commonly encountered are aphids, caterpillars, the greenhouse whitefly, the two-spotted spider mite, slugs, snails, sowbugs, and the garden symphylid. These pests frequently cause serious damage to the lettuce crop. Try to prevent infestations and apply control measures when these pests appear.

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[2] Prepared by A. L. Taylor, nematologist, Crops Research Division.

Prevention of Infestations

A good sanitary program is important in preventing infestations. Outside the greenhouse provide a clean strip free from weeds and crops that may harbor pests of lettuce. In the greenhouse eliminate trash and plant debris to prevent breeding and hiding places of these pests. If possible, grow transplants in a separate house free from pests so as to start with clean plants.

After harvesting a crop, apply a 10-percent parathion aerosol at 1 pound of solution per 25,000 cubic feet of greenhouse space to keep the greenhouse free of insect pests for a new crop. After applying the aerosol, keep the greenhouse closed overnight for maximum results. Fumigation with calcium cyanide at 4 ounces per 1,000 cubic feet of greenhouse space is also effective.

Precautions in the Use of Insecticides

Insecticides are poisonous. Handle them with care. Follow the directions and heed all precautions on the container label.

When handling or mixing concentrated insecticides, avoid spilling them on your skin and keep them out of your eyes, nose, and mouth. If you spill any on the skin or clothing, wash it off and change your clothing immediately. Wear a respirator and goggles when you are working with concentrated sprays or dusts.

Many insecticides can be absorbed directly through the skin in hazardous quantities. In applying them, try to keep them off your skin and away from your eyes, nose, and mouth. When you have finished using them, wash all exposed surfaces of the body with soap and water. Change your clothing if you have spilled any insecticide on it.

Parathion, TEPP, and calcium cyanide are extremely poisonous. They should be applied only by a person thoroughly familiar with their hazards and one who will assume full responsibility for safe use and comply with all the precautions on the labels.

Store insecticides in closed containers in a dry place where children, irresponsible persons, and animals cannot reach them.

Aerosols usually contain the poison gas methyl chloride. Regardless of the insecticide in these aerosols, they should be applied only by a trained operator who will enforce the precautions prescribed by the manufacturer and assume full responsibility for safety.

Do not use parathion on lettuce within 21 days or TEPP within 3 days before harvest. Do not use malathion within 10 days or nicotine sulfate within 7 days before harvest. Do not apply DDT to lettuce after the leaves to be marketed or eaten appear.

Aphids

Three species of aphids, or plant lice—foxglove aphid, green peach aphid, and potato aphid—are common pests of greenhouse lettuce. These insects are readily controlled with a parathion or malathion

aerosol, except in plots or benches of dense foliage. TEPP is then the most effective insecticide. Use a 10-percent parathion or malathion aerosol or a 5-percent TEPP aerosol at the rate of 1 pound of solution per 50,000 cubic feet of greenhouse space. One application is usually adequate. Malathion may also be applied to the foliage in wettable-powder or emulsion sprays. Use 1 pound of malathion per 100 gallons of water. Nicotine sulfate is also effective when applied to the foliage in a spray containing 1 quart of the 40-percent solution per 100 gallons of water.

Caterpillars

The caterpillars attacking lettuce include the armyworm, cabbage looper, and cutworms. These insect pests may be controlled with a 10-percent malathion or parathion aerosol applied at the rate of 1 pound of solution per 50,000 cubic feet of greenhouse space. Malathion may also be applied in a spray as for aphids. A 3-percent DDT dust is effective when applied to the foliage, but it should not be used after the leaves to be marketed or eaten appear.

Greenhouse Whitefly

The greenhouse whitefly is a common pest of greenhouse lettuce. It sucks the juices from the leaves. Infested plants become yellowish green and often stunted.

These insects may be controlled with a 10-percent parathion or malathion aerosol at the rate of 1 pound of solution per 50,000 cubic feet of greenhouse space. Repeat this treatment 2 to 3 times at 2-week intervals or until satisfactory control is obtained. Malathion may be used in a spray as for aphid control. A 5-percent TEPP aerosol is effective when applied at the rate of 1 pound of solution per 50,000 cubic feet of greenhouse space. Repeat this treatment every 5 days for 4 to 5 weeks.

Two-Spotted Spider Mite

The two-spotted spider mite is often troublesome. It feeds on the undersurface of the leaf and produces a chlorotic condition. In extreme cases the plants may be stunted or even killed.

Apply a 10-percent parathion or a 5-percent TEPP aerosol at the rate of 1 pound of solution per 50,000 cubic feet of greenhouse space. Two or three applications of the parathion aerosol at 7- to 10-day intervals are necessary to destroy an infestation. Repeat the TEPP treatment at 5-day intervals until the infestation is controlled.

Slugs, Snails, and Sowbugs

The presence of slugs and snails is revealed by their trail of slime, as well as feeding injury. They feed at night and hide by day under pots, benchboards, flats, or dense foliage.

Effective baits on the market usually contain metaldehyde with 2 percent of calcium arsenate or 5 percent of chlordane. Sprinkle the bait between the plants, or place about a teaspoonful in a pile at in-

tervals. Two or more applications may be required, as the slugs and snails may not feed every night but rest for several days between feedings. Use extreme care in applying these baits. Do not apply them to the foliage or excess residues may be left on the marketed crop.

Sowbugs feed at night or on cloudy days and hide by day under pots, boards, or trash. Apply a 3-percent DDT dust to the soil for effective control.

Garden Symphylid

Garden symphylids are present in the loose soil high in organic matter that is found in most greenhouses. They feed on the roots and do the most damage to young plants.

Soil sterilization (see p. 8) is the recommended method of control. First moisten the soil so that the symphylids will congregate near the surface, heat to 180° F., and hold at this temperature for 4 hours. The method most used in vegetable greenhouses makes use of buried lines of drain tiles spaced about 18 inches apart and connected by headers. Steam at 15 pounds' pressure is introduced into the headers. Suitable covers of plastic or special paper over the soil help retain the steam and insure sterilization of the soil surface. They also aid in getting heat penetration to the maximum depth. Sterilization by the inverted-pan method will destroy garden symphylids in raised benches.

LIST OF SCIENTIFIC NAMES

Fungi That Cause Diseases of Greenhouse Lettuce and Insects That Attack It

DISEASES

Common name	*Causal organism*
Anthracnose	*Marssonina panattoniana* (Berl.) Magn.
Bottom rot	*Rhizoctonia solani* Kuehn
Downy mildew	*Bremia lactucae* Regel
Drop	*Sclerotinia sclerotiorum* (Lib.) DBy. and *S. minor* Jagger
Gray mold	*Botrytis cinerea* Pers.
Rosette	*Rhizoctonia solani* Kuehn

INSECTS

Common name	*Scientific name*
Armyworm	*Pseudaletia unipuncta* (Haw.)
Cabbage looper	*Trichoplusia ni* (Hbn.)
Foxglove aphid	*Myzus solani* (Kltb.)
Garden symphylid	*Scutigerella immaculata* (Newp.)
Green peach aphid	*Myzus persicae* (Sulz.)
Greenhouse whitefly	*Trialeurodes vaporariorum* (Westw.)
Potato aphid	*Macrosiphum solanifolii* (Ashm.)
Two-spotted spider mite	*Tetranychus telarius* (L.)

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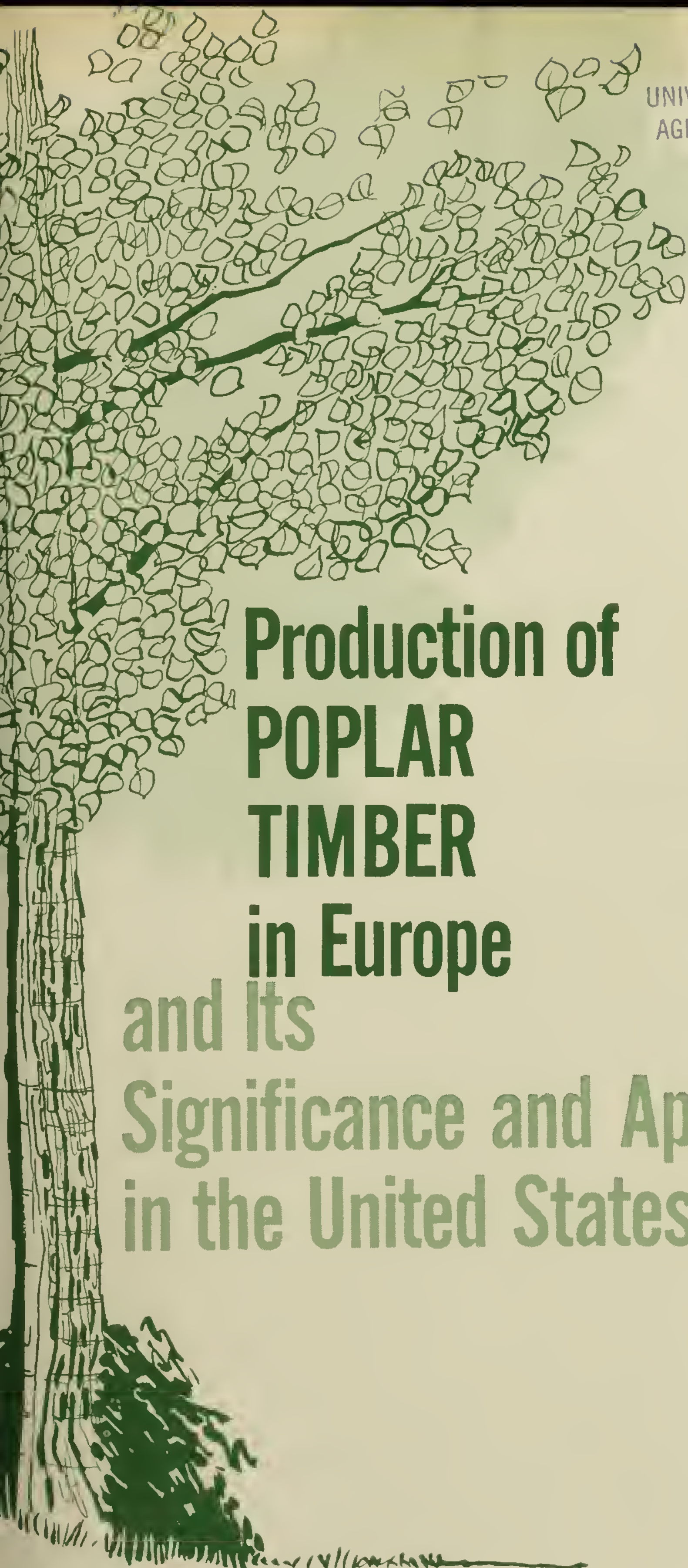

Production of POPLAR TIMBER in Europe and Its Significance and Application in the United States

AGRICULTURE HANDBOOK NO. 150

U. S. DEPARTMENT OF AGRICULTURE • FOREST SERVICE

Production of POPLAR TIMBER in Europe and Its Significance and Application in the United States

by

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U. S. DEPARTMENT OF AGRICULTURE **FOREST SERVICE**

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Production of Poplar Timber In Europe and its Significance and Application in the United States

INTRODUCTION

Between October 1951 and October 1952 the author studied poplar culture and research in western Europe, partly under a Fulbright Research Grant and partly under the auspices of the U.S. Forest Service. He attended the International Poplar Commission meetings and study tours in Spain in 1955, and in France in 1957, as official representative for the United States.

During these visits, which involved more than 30,000 miles of automobile travel (fig. 1), and through personal correspondence with poplar experts and growers in all the western European countries, he has had the opportunity to observe and collect information about European experience in poplar culture and research. This is his report on these studies, with special reference to the significance of European poplar work for the United States.

Since hybrid poplar culture started in Europe, there is much to be learned from the practices that have developed during the past 200 years. European poplar culture is impressively extensive and successful; but practice, and to some extent research, still lean heavily on traditional concepts and methods. The author has attempted to differentiate among the traditional, the biological, and the economic aspects of poplar production. Research will be necessary to test the biological and economic validity of some of the traditional practices.

There is now a worldwide interest in the use of hybrid poplars for timber production. Within recent years the interest in hybrid poplars has grown rapidly in the United States. For example, during the past 3 years the Northeastern Forest Experiment Station has received about 8,000 letters from farmers, landowners, and forest industries that wanted information about planting stock, planting methods, culture, and markets for poplar wood. This publication will, it is hoped, answer many of these questions.

The question of probable markets for hybrid poplar timber can be answered only for localities within the commercial range of our native poplars (cottonwoods and aspens) ; that is, where there is a present market for poplar timber. It will seldom be possible to profitably market the limited poplar production of one or even several small landowners where there is no industry that utilizes poplar within reasonable transportation distance.

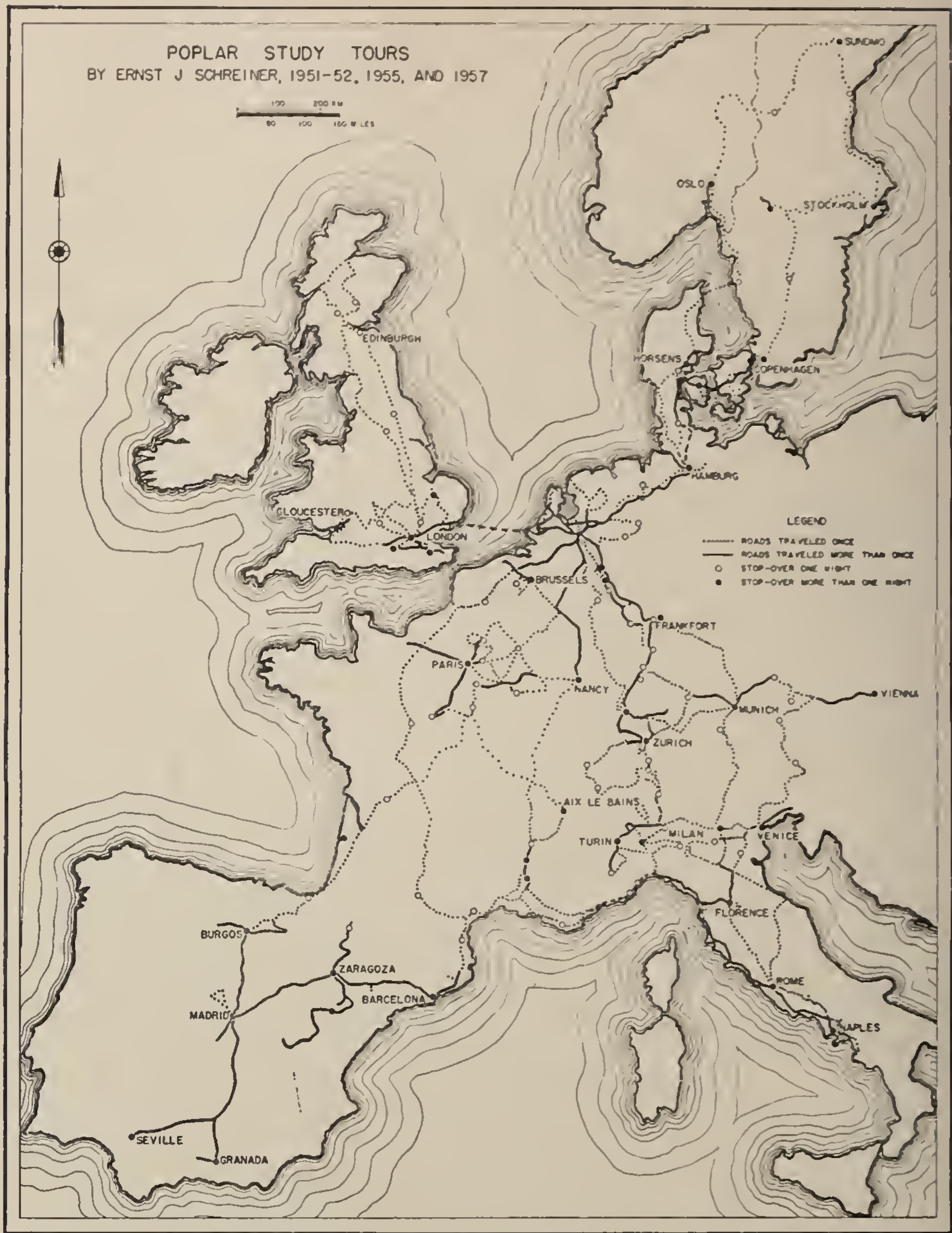

FIGURE 1.—The author traveled more than 30,000 miles by automobile in his studies of poplar culture and research, forest genetics, and general forestry, during visits to Europe in 1951–52, 1955, and 1957.

Where there is no present market, hybrid poplars can be expected to produce their potential share of the local timber wealth only if they are grown in sufficiently large quantities to attract industry. Existing local industries are not essential; with a sufficient and continuing supply of good poplar timber in sight, industry can be expected to compete for the product and even for the establishment of local conversion plants.

In localities where climate and soils are apparently suitable for poplar culture, but where there now are no available markets, it

would require the cooperation of many farmers and landowners to foster a production program on a scale that would create a profitable market. An essential first step in such new territory is the establishment of test and demonstration plantings. It would also be necessary to determine—

1. The economic limits of the proposed production area.
2. How much suitable poplar land would be available within the production area.
3. How many landowners would agree to plant poplar, and the acreage of suitable land the prospective growers would use for poplar production.
4. The possibility of agreement among prospective growers on a plan for continuous annual production (sustained yield). This would require agreement on a minimum acreage to be planted annually.
5. Whether the estimated annual production would create a reliable market.
6. The need and desirability for a local poplar-growers organization for mutual protection, cooperation, and exchange of ideas and information.

Demonstration and test plantings and a survey of local possibilities could be made by interested individuals, independently or under the sponsorship of local organizations. Successful demonstration plantings, established a few years before an action program on large-scale planting is contemplated, would provide the best argument for concerted action.

Predictions of costs and returns from hybrid poplar in the United States have not been included in this report for the following reasons:

1. European figures, based on the use of relatively cheap hand-labor and proportionately high prices for timber products, cannot be converted for American conditions with sufficient accuracy to justify their use.
2. Costs and returns in the United States will depend in large measure on the extent to which poplar production can be successfully mechanized. There is a lack of experience and cost information on this problem both in Europe and in this country.

HISTORY AND IMPORTANCE OF POPLAR IN EUROPE

It is usually convenient to have a more or less definite starting date for any historical sketch, but this is not possible for poplar culture in Europe. There is evidence that the native poplars of the Po Valley, which stretches across northern Italy from the French border to the Adriatic, were heavily exploited in Roman times. Here, as well as in southern Italy, the native poplars have been important for hundreds of years, to some extent planted but more often protected or at least favored where they occurred naturally.

In the Caudina Valley, a region of small land ownerships northeast of Naples, the poplar is used in a custom that has been handed down from generation to generation: at the birth of a daughter, it is customary for the father to plant a small number of poplars, usually about 100; and when the daughter marries, these trees are her dowry.

The native black poplar has also been used for centuries in parts of France, in the Low Countries, and in Germany along the lower Rhine. Poplar lumber has been found in German farm buildings old enough to indicate that the European poplar was used long before the American cottonwood brought hybrid vigor into European poplar culture.

Modern European poplar culture stems from the introduction of our American cottonwood about 250 years ago. During these two and a half centuries countless numbers of hybrids have been produced by natural hybridization between the American species and the European black poplar, followed by crossing between the hybrids and backcrossing between hybrids and the European parent species. Many of these hybrids were superior to the parent species in such characters as rate of growth, disease resistance, stem form, or other desirable characteristics. Since such natural hybrids could be propagated easily from cuttings, superior and especially vigorous wildlings were frequently used in local plantations.

The nurserymen and growers of the Parisian Basin were the first to select and exploit outstanding natural hybrids. Although France leads Europe in poplar acreage, in recent years it has been surpassed by several other countries in the intensity and efficiency of its poplar culture. A recent estimate indicates that there are, in round figures, 247,000 acres of poplar in France; and that approximately 40 percent (98,800 acres) of these plantations are in the Parisian Basin.

An annual increment between 150 and 160 cubic feet per acre is a reasonable estimate of the average productivity of all poplar plantations in France. On the basis of 155 cubic feet per acre per year, the total annual growth is approximately 38.3 million cubic feet (roughly 426,000 cords or 192 million board-feet).

The American cottonwood is reported to have been introduced into the Po Valley in northern Italy in 1770. Free and easy natural hybridization with the native black poplar followed the same pattern here as it did north of the Alps, but the earliest industrial use of hybrid poplars in this region was for pulpwood about 1890.

Expansion in Poplar Culture

Although poplar has long been an important bottom-land timber tree in many localities, recognition of its importance to the forest economy of Europe has increased astoundingly since the end of World War II. On the initiative of French, Belgian, and Netherlands poplar experts, the International Poplar Commission was organized in 1947 under sponsorship of the Food and Agriculture Organization of the United Nations.

The aim of the International Commission is to promote international collaboration in the study of scientific, technical, and economic questions relating to poplar. Most of the twenty-one member countries (France, Belgium, The Netherlands, Italy, the United Kingdom, Sweden, Switzerland, Austria, Hungary, Western Germany, Spain, Turkey, Argentina, Egypt, Iraq, Iran, Syria, Greece, Lebanon, Pakistan, and Yugoslavia) have national poplar commissions to promote the study and culture of poplars.

There are two major reasons for the great importance of poplar in Europe today: (1) the drastic shortage of wood in all countries, and (2) the rapid growth of poplar under proper culture on suitable sites. Farmers and small and large owners of land suitable for the growth of poplar can harvest these trees profitably in 12 to 25 years. In especially favorable localities in France, Germany, The Netherlands, and particularly Italy, poplar is the farmer's or landowner's most profitable crop.

Netherlands figures, based on all costs over a 25-year rotation (including soil rent, taxes, and interest at 3 percent on the invested capital) indicate a net profit of $9.50 to $12.50 (36 to 48 guilders) per tree. On the basis of 64 trees per acre (based on an average loss of 8 percent of the 70 trees originally planted) this is a net profit of $608 to $800 per acre.

The German Poplar Society has reported that the normal yield of widely spaced poplars on the bottom lands of the lower Rhine is 285.8 cubic feet per acre per year—a gross value of $96 per acre per year.

In the Po Valley of northern Italy, poplars grown on fertile agricultural land on 12- to 25-year rotations are said to produce a greater net return than any other agricultural crop.

Significance for the United States

The diverse and extensive timber supplies in the United States and our nationwide effort to conserve our forest heritage should prevent the drastic timber shortages that have made the role of hybrid poplar so important in Europe. Nevertheless, the rapid growth of hybrid poplars and their high productivity on sites suitable for their growth offers a profitable addition to our forest wealth. There is some land on most farms, and extensive areas in some of our major river valleys, on which hybrid poplars would be more productive than any other timber tree.

There is a demand for poplar in many parts of the United States at the present time. And hybrid poplar timber can meet the requirements of industries that are now using other and less rapid-growing native species. Since the International Poplar Commission has become the worldwide clearing house for the exchange of information on the production and utilization of poplar timber, poplar culture in the United States can reap rich benefits from the work of the Commission.

POPLARS GROWN COMMERCIALLY IN EUROPE

Northern Europe

Denmark, Sweden, Norway.—The match industries in these countries are strongly prejudiced in favor of aspen for matchwood and are reluctant to use the Aigeiros hybrids. In some respects aspen wood does make a somewhat better match, but the difference seems rather insignificant for purposes of usability and salability. This observation is based on the almost exclusive use of Aigeiros hybrids for matchwood on the Continent.

There are sound biological reasons for the importance of aspen in Sweden and Norway. Most important are the naturally regenerated aspen stands (*Populus tremula* L.). Furthermore, river bottom-land sites, generally considered essential for the most profitable culture of Aigeiros hybrids, are much more limited than on the Continent.

The strongest demand at present for poplar planting stock in Denmark, Sweden, and Norway is for first generation (F_1 hybrids between European and American aspens (*P. tremula* × *tremuloides* Michx.). This demand is so large that it cannot be met by the nurseries that are engaged exclusively in mass production of these F_1 hybrids.

Aigeiros poplars and hybrids have been planted to some extent in Denmark for windbreaks but many of these are branchy types that are not used by the match industry. Tacamahaca hybrids of the type of *P. ×berolinensis* Dipp.[1] have grown well but have not been generally disease resistant. Specimens of both Aigeiros and Tacamahaca hybrids in gardens, hedgerows, and along roadsides indicate that carefully selected clones of these poplars might fill an important niche in the forest economy of Denmark.

The Netherlands.—Occasional natural hybrids were undoubtedly selected in the past for clonal propagation by farmers and nurserymen, but the number of clones cultivated in The Netherlands was never so large as in some other countries of Europe. One probable reason is that natural regeneration from seed, which under European cultural conditions almost invariably produces new hybrids, was limited in The Netherlands by the intensive utilization of land along the rivers and canals for agriculture—particularly for forage. Hay and grazing in the poplar plantations and on the overflow lands along the riverbanks is extremely unfavorable to survival of poplar seedlings.

The excellent studies of the late Prof. G. Houtzagers of the Forest School in Wageningen, published under the title "Het Geslacht Populus in Verband met Zijn Beteekanis voor de Houtteelt"

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[1] The poplar names used in this report conform to the International Code. The application of these rules to the cultivated poplars, and synonymous names in European poplar literature or in local use, are discussed in the appendix.

(The Genus Populus and its Significance in Silviculture) laid the groundwork for clonal certification in The Netherlands. The following poplars are now in commercial use: *P.* 'Heidemij,' 'I–214,' 'Robusta,' 'Robusta Zeeland,' 'Robusta Vernirubens,' 'Robusta Bachelieri,' 'Marilandica,' 'Gelrica' (fig. 2), 'Manitobensis,' 'Serotina,' and 'Serotina Keppelse Groene.' Most of these clones have been studied and tested for more than 20 years. They have been subjected to pathological tests intensive enough to justify their certification as resistant to the type of bacterial canker that is present in The Netherlands.

Photo by G. HOUTZAGERS

FIGURE 2.—Twelve-year-old poplar clonal test in Best, The Netherlands. At left is *Populus* 'Gelrica,' at right 'Marilandica.' Note the difference in size and stem form.

Clonal identity is controlled under strict government regulation. Every poplar sold must carry a tag of the Netherlands Inspection Service for Nursery Stock certifying the clonal identity and plant quality. Certified cuttings are available only from a central nursery, originally established by the Netherlands Land Reclamation Society.[2]

Commercial nurserymen are permitted to take cuttings from each purchase of certified cutting stock only as long as the State inspector is certain that there is no danger of mixing clones. State inspectors go through every commercial nursery twice during the first year and once in each succeeding year until the stock is sold. Before the trees are dug for sale, an inspector labels each tree with a certification tag (fig. 3). This is the most intensive federal certification system in Europe.

[2] Early in 1956 this nursery was transferred to the Foundation for Improvement of Breeding Basic Materials for Forest Stands (Stichting ter Verbetering van Voortkwekingsmaterial van Houtopstanden).

N. A. K. B. photo

FIGURE 3.—Certification of poplars in a Netherlands nursery by an inspector of the Netherlands Inspection Service for Nursery Stock. This nursery stock is ready for sale. Each tree is individually tagged.

Central Europe

Belgium.—The poplars most generally planted in the past were the same mixtures of clones used in France, but in recent years the certified Netherlands clones have come into increasing use in Belgium. Between 1940 and 1950 the Belgian Match Company[3] used *Populus* 'Robusta' almost exclusively in its plantations. About 1950, 50 to 60 percent of their plantings were 'Serotina Erecta' and the remainder 'Robusta.' Select clones from many countries in Europe are being tested at the Company's Poplar Institute in Grammont.

Germany.—The poplar types commonly planted in the past in the principal poplar regions of Germany were *P.* 'Robusta,' 'Serotina,' 'Regenerata,' and 'Marilandica.' Types of *P.* ×*berolinensis* were widely planted in the northwest. Although their susceptibility to disease has brought them into disrepute, they are still used rather extensively for roadside and street trees. In Schleswig-Holstein and the coastal region along the North Sea, *P.*×*canescens* (Ait.) Sm. cultivars are still favored for windbreaks because of their windfirmness and their adaptability to coastal conditions.

The extensive poplar plantings in the Rhine bottom lands in Baden exhibit clonal mixtures that have probably been derived through local selection and clonal propagation of natural hybrids. Such natural crossing could have been between hybrids (apparently the older French hybrids) and backcrosses to the native *P. nigra* L., which is still surprisingly common on the flood lands of the Rhine.

Since 1950 the German Poplar Society has certified poplar nursery stock, on the basis of nursery inspections, as to cultivar name, condition, and health. Certified stock bears a protected trademark label, which is attached to individual trees or to bundles of not more than 10 trees. Participation by commercial nurseries is voluntary. Following are some of the cultivars certified for sale during the winter of 1956–57: *P. alba* L., *P.* ×*canescens,* and *P. trichocarpa* Torr. & Grey, all with indication of clone; *P.* 'Heidemij' and 'Gelrica,' both from The Netherlands; and 'Regenerata,' 'Robusta,' 'Serotina,' 'Eugenei Feminine,' 'Robusta Vernirubens,' 'Marilandica,' 'Eukalyptus,' 'Allenstein,' 'Bietigheim,' 'Drömling,' 'Eckhof,' 'Grandis,' 'Isar,' 'Leipsig,' 'Löns,' 'Neupotz,' and 'Flachslanden.'

Great Britain.—Poplar culture has not been extensive in Great Britain. A few commercial plantations have been established from time to time; but in general, poplars have been produced in only small quantities by commercial nurseries for ornamental and windbreak planting.

As on the Continent, the poplar types that have been planted in Great Britain represent a mixture of clones. Even the artificial hybrid *P.* ×*generosa* Henry is a clonal mixture because Henry

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[3] The Union Allumettière S.A., which does not lend itself to exact translation, is referred to in this report as "The Belgian Match Company." In the same way, the Service d'Exploitation Industrielle des Tabacs et des Allumettes (SEITA) is referred to as "The French Match Company."

distributed cuttings of a number of taxonomically similar F_1 male and female seedlings under this name.

In addition to the natural species (*P. alba*, *P. tremula* L., *P. nigra*, *P. deltoides* Bartr., *P. trichocarpa*, and *P. balsamifera* L.), one or more clones of the following hybrids have been grown in Great Britain: *P.* 'Serotina,' 'Regenerata,' 'Eugenei,' 'Robusta,' 'Marilandica,' 'Lloydii,' ×*generosa* and ×*berolinensis*.

On the basis of climatic adaptability, growth and development, and particularly disease and insect resistance, the Forestry Commission has for the present limited its recommendation for commercial planting to the following clones: *P.* 'Serotina,' the so-called 'Serotina Erecta,' 'Robusta' (fig. 4), 'Gelrica,' and 'Eugenei.' *P.* ×*berolinensis* is recommended for shade and ornamental planting.

France.—The poplars that have been most commonly planted in France are *P.* 'Italica,' 'Blanc de Garonne,' 'Vert de Garonne,' 'Carolin,' 'Angulata,' 'Virginiana,' 'Monilifera,' 'Serotina,' 'Serotina de Champagne,' 'Serotina du Poitou' 'Regenerata,' 'Robusta,' 'Eugenei,' Marilandica,' and 'Regenerata d'Hautervive.' These names have not in all cases characterized or assured pure (single) clones as in The Netherlands.

In the region of Parthois, in the Marne Valley, there are reported to be approximately 49,000 acres of poplar, 80 percent of which is called *P.* 'Virginiana,' the remaining 20 percent 'Robusta' and 'Regenerata.' The 'Virginiana,' although rather crooked in stem form, grows about as well as 'Robusta' on the good sites and somewhat better than 'Robusta' on the poorer sites. The occurrence of both sexes in plantations believed by the owners to be 'Virginiana' is irrefutable evidence of a clonal mixture. Considerable variation in stem form (crookedness) is collaborative evidence, because on any particular site uniformly spaced ramets of a single clone would exhibit only slight variation in growth habit. The new terms "ramet" and "ortet," which are used in this report, are defined in the appendix, p. 112.

In the valley of Garonne, a poplar locally called Carolinensis was most common until about 30 years ago. It is said to be the best type for this region but does not root so readily from cuttings as other clones. *P.* 'Robusta,' 'Regenerata,' 'Vert de Garrone,' and 'Blanc de Garonne' are now most commonly planted here.

P. 'Italica' has been widely planted in southern France, where the wood is preferred for construction lumber. It is obvious from the wide variation in growth habit (from fastigiate to columnar) and the occurrence of both sexes that this name has covered a mixture of clones. The cultivars 'Robusta,' 'Regenerata,' and 'Serotina' are now most extensively planted.

Excellent naturally regenerating stands of *P. alba* occur in some of the river valleys of southern France. *P.* ×*canescens* cultivars (hybrids between *P. alba* and *P. tremula*) are generally considered to grow better than Aigeiros poplars on dry and on excessively wet sites; and like *P. alba* they are used frequently as ornamental and roadside trees. Cultivars of *P.* ×*canescens* are occasionally planted for lumber production but not for matchwood because the wood is said to be too rough.

Great Britain Forestry Commission photo

Figure 4.—*Populus* 'Robusta' about 18 years old, at Kett's Wood, Ryston Hall, England.

The following poplars are recommended by the French Forest Service for planting in the several poplar regions of France:

Western Parisian Basin: *P.* 'Serotina de Champagne,' 'Serotina du Poitou.'

Eastern Parisian Basin: *P.* 'Serotina de Champagne,' 'Robusta,' 'Virginiana.'

Western Region (Bretagne, Secteur Ligerien, Charentes): *P.* 'Serotina du Poitou,' 'Robusta,' 'Regenerata,' 'Virginiana.'

Southwestern Region: *P.* 'Blanc de Garonne,' 'Regenerata,' 'Virginiana Carolin.'

Southeastern Region (Secteur Rhodanien): *P.* 'Regenerata,' 'Angulata,' 'Robusta,' 'Virginiana.'

Switzerland.—Poplar culture in Switzerland has been limited by the scarcity of available bottom-land sites. *P.* 'Robusta,' 'Regenerata,' and 'Serotina,' are now most commonly planted. The types grown during the past 50 years in the vicinity of Yvonand on Lake Neuchatel and Noville at the head of Lake Geneva are believed to have been imported originally from French nurseries. In Tessin, in the valley below Bellinzona, there are some small poplar plantations for which the planting stock may have come from Italy. There is some evidence that a few clonal derivatives of local natural hybridization have come into cultivation in Switzerland within the present century.

Southern Europe

Italy.—The introduction of the American cottonwood into the Po Valley in 1790, and of the older European hybrids somewhat later, set the stage for extensive natural hybridization with the native black poplar (*P. nigra*). The natural hybrid population now represents many kinds and degrees of intercrosses and backcrosses to the originally more abundant *P. nigra.*

The almost phenomenal economic importance of hybrid poplar in Italy today is attributable in large measure to the excellent work and enthusiasm of Prof. Giacomo Piccarolo and his associates at the Institute for Poplar Research at Casale Monferrato. By 1928, when epidemic spring dieback (Defogliazone primaverile), and to a lesser degree leaf rust, had become a serious threat to profitable poplar culture, the plantations in northern Italy already contained innumerable natural hybrids.

As a result of selection and tests of thousands of natural hybrids during the past 20 years by the Poplar Institute and several other organizations, the following clones are recommended for planting in Italy: *P.* 'I–37,' 'I–137,' 'I–154,' 'I–214,' 'I–262,' 'I–455,' 'I–477,' and 'I–Caroliniano Bianco de Cercenasco.' With the exception of the last, these clones have not yet (1957) been given clonal names. They are grown and sold under clonal numbers, the capital "I" indicating Italian origin. The greatest demand is for clone 'I–214' because of its vigorous growth and disease resistance.

Spain.—European black poplars, especially columnar and fastigiate types like the Lombardy poplar, have been planted along

many Spanish highways and river bottom lands. For centuries they have characterized the Castilian roadsides under conditions that are too dry for many trees. Poplars are often the principal source of lumber and of fagots for fuel; in some localities even the fallen leaves have been used for fuel.

Poplar culture has been locally important for centuries, particularly in the Mediterranean region and in the Duero and Tajo Valleys of Spain. In addition to numerous cultivars of the European black poplar, there are also many Aigeiros hybrids in cultivation (fig. 5). The original source of most of these hybrids is obscure, but the most probable guess would be imported cultivars and local selections of natural hybrids.

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FIGURE 5.—A 6-year-old poplar plantation in the Genil River Valley near Granada, Spain. The first thinning had been made in this plantation during the previous winter.

In the region between Barcelona and Gerona, the four cultivars that have been most widely planted are *P.* 'Mainou,' 'Bordils,' 'Poncella,' and 'Polla Carolina.' The last was practically eliminated by disease some 35 years ago. *P. alba* occurs naturally and as occasional trees in plantations of other cultivars; it is not commonly planted. Two cultivars, 'Blanquillo' and 'Nigrito,' are recognized in the region of Granada. In the Province of Logrono the most commonly grown poplars are the locally called canadensis and 'Italica.' In Aragon, cultivars of the European black poplar are grown as pollards from which 10 to 15 stems are cut at 10- to 12-year intervals.

Significance for the United States

One of the objectives of this study was an investigation of the silvicultural characteristics (such as site requirements, growth rate, and disease and insect resistance) of the poplars that are grown commercially or are being tested in Europe. Only empirical and inconclusive answers are available on these questions, primarily because of the confusion in naming hybrid poplar clones and the impossibility of exactly identifying taxonomically similar clones. We should avoid similar confusion in the expansion of poplar culture in the United States. (See appendix p. 112, Identification and Naming of Poplars.)

The search for, selection, and testing of superior individual trees of native poplars, and of natural and artificial hybrids, has greatly increased in recent years in various parts of the United States. Such selections should always be maintained as single clones, never as mixtures of ramets from trees that appear to be similar. Clones should be carried under number till they have been adequately tested and are ready for commercial distribution. With a continuous and increasing number of new clones, national registration will eventually become necessary for the protection of the grower.

SELECTION AND BREEDING

Clonal Selection

Selection of superior individual trees is a major activity of poplar specialists and growers in almost every European country. They generally recognize that there is an essential and continuing job to obtain better clones for future use and to replace those that may fall prey to unusual environmental conditions or to new diseases and insects. Selection offers excellent possibilities in many sections of Europe because of the many hybrid clones in the plantations and the ease and frequency of natural hybridization.

In the Rhine Valley near Bonn there is an excellent example of the possibilities for frequent and abundant natural hybridization and backcrossing. A female *Populus* 'Regenerata' and a male 'Serotina,' estimated to be at least 90 years old, are growing a short distance apart on an old estate. These two clones, and possibly others including early local hybrids, have been planted extensively in mixed or adjacent plantations. In an open area near such a 50-year-old stand there were, in 1952, literally thousands of seedlings from the 1949 seed crop. Dr. Müller, director of the Research Institute of the German Poplar Society, had selected a large number of the best of these natural hybrids for clonal tests.

Except for the Swedish tests, very few clonal tests have been designed for precise statistical analysis. Many new selections are being multiplied for immediate use on the basis of phenotypic excellence of the ortet and the nursery performance of the cuttings.

Where new selections have been tested in plantations, the field layout was seldom designed to permit statistical evaluation of results. One or more factors, such as type of planting stock, time of planting, planting methods, culture, site differences, or soil heterogeneity within the plantation, are almost always completely confounded. Although such clonal selection will bring some elite clones into immediate use, these empirical testing methods will not provide the basic comparisons that are required for scientifically sound clonal evaluation.

The Netherlands.—The clones selected by the late Prof. Houtzagers during the 1930's as the best of those grown in The Netherlands have been under test on 3 different sites for more than 20 years by the Netherlands Land Reclamation Society (fig. 6). These are among the clones now certified by the State for commercial planting. New clones must be tested for 5 years before they can be included in the list of poplars that can be certified for sale.

Photo by G. HOUTZAGERS

FIGURE 6.—A spring photograph in the clonal test plantation of the Netherlands Land Reclamation Society at Elst, The Netherlands. At left is *Populus* 'Heidemij,' at right 'Serotina Erecta.' There is considerable difference in time of leafing.

Additional certified clones are needed and desired in The Netherlands, but conditions do not favor the production and survival of natural hybrids in sufficiently large numbers for profitable selection. A relatively few local selections are being made, but the emphasis is quite correctly put on controlled breeding and on testing the best clones from other countries.

The most promising clones from many countries are being propagated in the central poplar nursery formerly located at Keppel but now at Wageningen. A full-time pathologist is assigned to investigate disease resistance in these clones, particularly resistance to artificial inoculation with bacterial canker.

Clones that had demonstrated satisfactory growth and reasonable disease resistance in the nursery were outplanted in 1950 in an extensive and well-designed clonal test on the new Northeast Polder. It was planned to inoculate trees at regular intervals throughout the test plantations with bacterial canker and other native diseases to permit evaluation of clonal resistance to natural infection—the procedure used for more than 25 years in poplar research in the northeastern United States.

Italy.—Clonal selection and testing has been extensively practiced in Italy along two different lines: (1) propagation and testing of seedlings from open-pollinated seed of selected mother trees; and (2) selection and direct propagation (by cuttings) of outstanding trees.

The Institute for Poplar Research at Casale Monferrato has carried on large-scale selection through naturally pollinated seed from selected mother trees. In past years the Institute has grown more than 20,000 seedlings per year (in some years 100,000) for nursery selection. The most vigorous seedlings that are resistant to spring dieback and leaf rust and have good stem and crown form have been tested for rooting ability. After the second year in the nursery the very best have been planted in a selection arboretum and then multiplied for 15- to 20-year clonal plantation tests. By 1948 more than 1,800 clones derived from open-pollinated seed of selected mother trees had been established in test plantations by cooperators in various localities in northern Italy. Several ramets of each clone were planted in each test plantation. Selections of the best clones in the oldest of these plots are already being propagated for commercial planting.

Prof. Aldo Pavari, director of the Forest Experiment Station in Florence, established a test plantation of 24 clones at Monsummano in 1941, 1942, and 1943. Ten of the best early selections of the Institute at Casale Monferrato (including 'I–214') and 14 named clones of Italian origin were included in this test. The clone *Populus* 'I–Caroliniano Bianco de Cercenasco' was considered the best in 1952.

Germany.—Since the war there has been tremendous activity in the selection of excellent local trees in all the poplar-growing regions of Germany. Local selections are being propagated by farmers, nurserymen, estate foresters, State foresters, and research stations. Propagation is usually from single ortets and these can be registered in several of the States as single clones.

Cuttings from several taxonomically similar ortets may also be propagated under a single name or number, but these must be registered as a clonal mixture—"Clone Gemisch." In most cases the phenotypic excellence of the selected ortets, supported only by vigorous nursery growth, is accepted as sufficient evidence to warrant multiplication for immediate use in practice.

The Forschungsstelle für Flurholzanbau der Lignikultur in Reinbek near Hamburg, as the name implies, is sponsoring the production of wood outside the forest; i.e., windbreak, hedgerow, and roadside planting of poplars and willows. Although this research station is testing poplar selections from all countries, it is particularly stressing local selections from northwestern Germany. If these local selections appear satisfactory after several years in the test nursery they are recommended for use in the locality where the ortet was selected. By this procedure the station expects to find the best clones for specific localities.

The Federal Institut für Forstgenetik und Forstpflanzenzüchtung, in Schmalenbeck near Hamburg, has a collection of more than 300 selected clones from Europe and America. The best clones, as determined by nursery performance, will be tested in plantations.

In the Niedersachsischen Pappelmuttergarten in Harsefeld, the State Forest Service has a collection of more than 200 clones, derived from selected local ortets, seedlings from controlled crosses, and some exotic clones. Small numbers of trees of each of these clones are tested in Lower Saxony for comparison with the best registered types. New clones that are as good as or better than the best clones in local use are then propagated in larger numbers. This is a continuing program to obtain better clones and to replace those that may fall prey to unusual environmental conditions, diseases, or insects.

Between 1947 and 1952 the Research Institute of the German Poplar Society sponsored trial plantings of 18 poplar cultivars in approximately 150 cooperative plantations scattered throughout western Germany. During 1951 and 1952 the South German Branch of the Society established another 150 cooperative test plantings in Bavaria. The total number of trees in each planting varied from 100 to 200 and included 10 or 20 trees of each poplar cultivar. Planting stock (1- or 2-year-old trees) was purchased from certified commercial nurseries.

Because these were primarily demonstration plantings, their experimental design will provide only empirical clonal comparisons. The published objectives are (1) to demonstrate the economic possibilities and techniques of poplar culture; (2) to demonstrate choice of correct sites and soils in river bottoms, uplands, forests, and fields; and (3) to compare the most promising poplar cultivars under different environmental conditions.

In Baden, Dr. Friedrich Bauer (formerly Oberlandforstmeister, now at the Forestry Institute of the University of Freiburg) correlates his selections with the site and soil on which the elite ortets (fig. 7) are growing. He has made selections of excellent phenotypes from good poplar sites, dry sites, extremely heavy

soils, wet peaty soils, and climatically unfavorable upland sites. These selections are propagated in 10 small state nurseries in Baden, each selection being propagated on sites and soils as similar as possible to the site on which the ortet was found (fig. 8).

Soil specifications include depth of water table, fertility, pH near the surface, and difference in pH between surface and lower soil level. Baden state foresters who order cuttings are required to provide standardized information, by numbers and symbols according to a guide sheet, on their proposed poplar planting sites. The guide sheet covers geographic location, elevation—for climatic information, site information on soil-water relations, soil structure, fertility, depth, and pH. On the basis of this information, clones from ortets selected from similar sites and soils are provided for planting. Statistically controlled clonal tests had not been established to compare the selected clones on similar sites or on a series of different sites and soils.

Photo by F. BAUER

FIGURE 7.—One of Dr. Bauer's selected ortets in the Rhine bottom lands of Baden, Germany. The branches have been removed to produce sucker growth suitable for cuttings.

In the Füllbroch State Forest, Dr. Bauer had an interesting 15-year-old test of clones derived from crooked parent trees. The ramets had been carefully trimmed and pruned every year to produce straight stems, but the trees were still crooked.

Several specimens of burly native *P. nigra* were observed in the Rhine bottom-land forests of Baden. These are called "Maser Pappel" in Germany and the wood is referred to as "Mappa Holz" by local furniture manufacturers in Baden. The wood brings a high price for face veneer, the price depending on the degree and regular distribution of the burl. The average burly log was said to bring about $700 per thousand board-feet. There apparently has been no selection of the best burly trees for clonal propagation.

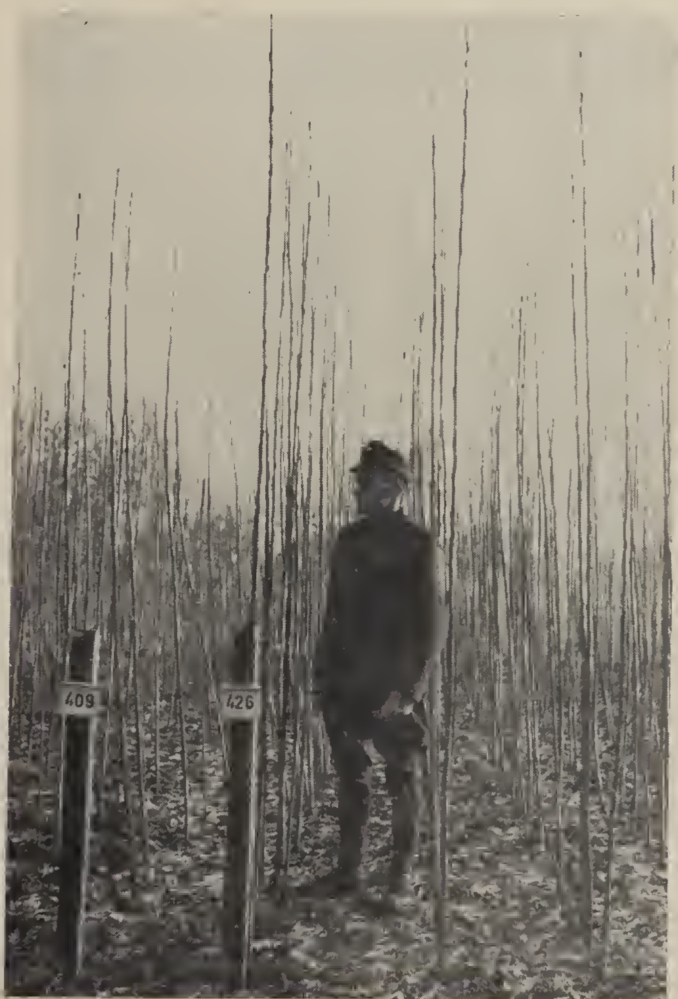

Photo by F. BAUER

FIGURE 8.—One-year-old rooted cuttings of selected clones in one of the state poplar nurseries in Baden, Germany.

Many private growers and nurseries in Germany—too many for individual mention—are selecting and propagating elite trees. The Harff poplars (fig. 9)—selected and propagated under the supervision of Dr. Bruno Schmitz-Lenders, who has worked with

poplars for many years—the Ruskamp poplars, and the Moos poplars are well known in western Germany.

Sweden.—The search for and selection of natural triploids and "plus" trees of the native aspen was an important part of the

Photo by SCHMITZ-LENDERS

FIGURE 9.—Fifty-year-old Harff poplar on excellent bottom land along the river Erft, District of Cologne, Germany. Its d. b. h. is 45½ inches, total height 140 feet, total volume without bark (to 2.75-inch top) 494 cubic feet, including approximately 400 cubic feet of veneer and saw logs.

early work of the Swedish Tree Breeding Institute. The growth rate of these natural triploids, one clone of which was observed at the forest estate Satra, is higher than that of the diploids. The small stand at Satra, about 60 years old, is considered to be of clonal origin (through root suckers) from a single ortet. Clonal propagation of triploids and of diploid "plus" trees has not been started on a commercial scale. The selected trees have been used for intraspecific and interspecific breeding.

It is too early to compare the yield of Aigeiros hybrids with that of the aspen hybrids, but observations on roadside trees growing on upland sites in Sweden and Norway warrant the prediction that on good sites Aigeiros hybrids and hybrids between Aigeiros and Tacamahaca poplars will grow faster than the aspen hybrids. Such roadside trees have already been subjected to some degree of selection for adaptability to specific environment. Selection and breeding with these types has lagged in Sweden and Norway because sites suitable for their culture are limited and because the match industry in these countries prefers aspen.

Great Britain.—A collection of poplars for clonal tests was begun by the Forestry Commission in the middle 1930's under the direction of W. H. Guillebaud, but the war interrupted this work while most of the collection was still in the nursery. Poplars have received increasing attention since the end of the war. Large-scale field trials of the most promising clones in the collection of the Forestry Commission Research Branch, which were started in 1948 by T. R. Peace, are being expanded in various parts of England, Scotland, and Wales. Some of these are British selections, but the majority are the best clones from other countries of Europe and from America. All clones are subjected to artificial inoculation tests for resistance to bacterial canker.

Belgium.—The Dongelberg experimental plot established by Professor Poskin is apparently the oldest clonal test in this country. This test planting was established with commercial stocks used in Belgium. On the basis of sex and time of leafing, Professor Poskin believes there are at least eight clones of *P.* 'Robusta' in this plantation. There are also several clones of 'Regenerata,' most of which, but not all, are susceptible to a disease that closely resembles, and may be, bacterial canker.

The best clones from all countries are being tested at the Institut de Populiculture of the Union Allumettière in Grammont. The most promising clones in nursery trials are tested in plantations. This work is too recent for any conclusive results.

In 1952 the Direction Generale de Eaux et Forêts established an arboretum at Egenhoven-Bos, near Louvain, with five ramets each of clones that appear promising for commercial use in Belgium.

France.—Between 1949 and 1955 the Direction Generale de Eaux et Forêts established 15 poplar "forest arboretums" throughout France. These plantings total 156 acres and contain 11,200 trees. The trees are under regular observation and measurement.

Previous to 1952 the Department had also established poplar nurseries at Blois and in southern France to provide certified cutting stock. It is not clear whether all the stocks in these nurseries represent pure clones derived from cuttings from single trees or whether they were derived from cuttings taken from several ortets that have the same taxonomic characteristics. In a letter dated June 1, 1956, Dr. J. Pourtet stated that a new poplar nursery, representing pure clones, will replace these earlier nurseries.

The National Forest Research Station at Nancy is making selections of native *P. tremula* in which they recognize two races, a mountain race and a plains race. The races are reported to differ in the ratio of leaf length to width, in the lenticels, and in the character of the bark. Selections of superior straight-boled trees are being made in both races.

Switzerland.—Clonal selection and testing was started in Switzerland by the Federal Forest Experiment Station, located in Zurich. In 1950, Dr. Fritz Fischer established a poplar arboretum at Giritz near Koblenz with Swiss selections and some of the best clones from other countries. Field tests have also been started or are planned in other localities such as Lac de Neuchatel, Noville, and in the vicinity of Bellinzona.

In 1954 the Forest School in Zurich took over the work with Aigeiros poplars and with hybrids within this section for bottomland planting. The Federal Forest Experiment Station is now handling the selection and testing of Tacamahaca poplars and their hybrids, including intersection hybrids, for planting on upland sites.

Spain.—Selection of elite ortets for local use has been a common practice of the growers in the poplar regions of Spain. This is being continued by the government foresters responsible for poplar reforestation and by the Forest Research Institute. Favorable local environments for natural hybridization and survival of seedlings have provided some excellent phenotypes for selection. There is also good *P. alba* in southeastern Spain. An excellent specimen of this species was observed in a 25- to 30-year-old plantation of Lombardy-type poplars near Hostalrich. This tree, the only white poplar in the plantation, was 22 inches in d. b. h. and 100 feet in total height, and it had almost 60 feet of clear trunk.

In addition to selections for vigor, disease resistance, and tree form, selections are now being directed toward good phenotypes that are growing on dry sites. The Spanish foresters are also interested in *P. euphratica* Olivier, which is reputed to grow on alkaline soils. Unfortunately this poplar does not root from cuttings.

Since 1950 many of the best clones from Germany, France, The Netherlands, Italy, Morocco, Syria, and the United States, and clones derived from selected Spanish ortets, have been propagated at the Institute for Forest Research in Madrid. Selections include burly poplars for furniture face veneer. After preliminary observation and selection in the 20-acre experimental nursery, the most promising clones are tested in plantations throughout the country.

Controlled Breeding

Denmark.—Poplar breeding in Denmark has been done almost exclusively with the aspens. As a result of Dr. C. Syrach Larsen's demonstration of hybrid vigor in crosses between *P. tremula* and *P. tremuloides*, the experimental poplar nursery of the Danish Match Company at Hellestrup has been converted to a breeding station for the commercial production of F_1 hybrid aspens. An estimated 150,000 two-year hybrid aspen seedlings were being produced here in 1952. This was insufficient to meet the increasing demand.

Mass pollination is carried out in two greenhouses with lighting facilities for additional artificial illumination to hasten blooming and fruiting. One house is heated for early work in February, the other is unheated for work later in the season. These breeding houses have small pollination chambers arranged along one side for special small-scale pollination work, but the open benches are used for the mass pollinations.

Approximately one-fourth of the annual seed production has been obtained from early pollinations on some 400 grafted plants (in pots) of 15 selected female clones of *P. tremula*. Three-fourths of the hybrid seed production has been on large flowering branches 3 to 4½ feet long, cut from native *P. tremula* trees growing in various parts of Denmark. The flowering branches are brought into bloom in pails of water on the greenhouse bench and are pollinated by hand dusting. In the past most of the *P. tremuloides* pollen has been obtained from Canada.

The fruiting catkins are collected before they are fully open and are placed in glass-covered boxes in which the catkins are spread out one layer deep on screens until they open. The seed is cleaned in a small, screened, rotating drum with a fan to blow the seeds through the wire screen. The cotton stays inside the drum.

The Hellestrup Nursery maintains a record of the parentage of each seed lot and a record of where the hybrid seedlings are outplanted. The growth and development of the individual progenies will be checked to select the best parents for future hybridization.

A large number of *P. tremuloides* clones and seedlings of selected trees from eastern and western Canada, collected by Dr. Larsen, have been planted in the arboretum at Hellestrup. These will be used as parent stocks as soon as they come into bloom.

Sweden.—Aspen breeding has been one of the projects of the Swedish Tree Breeding Institute in Ekebo and the branch stations in Brunsberg and Sundmo since its founding in 1936. The experimental breeding has included intraspecific crossing of "plus" trees of *P. tremula*, polyploidy breeding, and species hybridization. The Institute had also mass-produced *tremula* × *tremuloides* hybrids for commercial sale when this did not interfere with research. In 1951 they produced and sold about 20,000 one-year hybrid seedlings.

The progenies derived from crosses between "plus" trees of *P. tremula* have not been as rapid growing as the aspen hybrids. For this reason production of commercial planting stock from mass-

produced seed of "plus" trees of *P. tremula* has been overshadowed by the demand for F_1 hybrids of *tremula* × *tremuloides*. There has been little demand for the mass production of triploid *P. tremula* (obtained by crossing *diploid* × *tetraploid*) apparently because of the variability of the seed progenies. The seedlings range in vigor from those that equal the hybrid aspens in growth rate to very poorly growing, almost dwarf individuals that are graded as nursery discards. Triploid species hybrids, between diploid *P. tremuloides* and tetraploid *P. tremula*, are particularly promising. Selected fast-growing and disease-resistant triploid clones will undoubtedly find a ready market when commercial vegetative propagation is started.

The Swedish Match Company maintains Mykinge Försöksgård, an experimental area near Jönköping, in which some of the Ekebo aspen progenies are being field tested. A planting of *P. tremula* × *tremuloides* hybrids made in 1943 with 1-year seedlings on an area logged in 1941 clearly demonstrates their early vigor. Although this site was covered by a dense stand of root suckers when the hybrids were planted, the native aspens were completely suppressed by 1950. In the 1947 plantation of 1-year-old seedlings of *tremuloides* × *tremula*, *tremula* × *tremuloides*, and crosses between selected diploid *tremula* parents, the most uniformly vigorous progenies were the *tremuloides* × *tremula* hybrids; the direction of the cross seems to make little difference in vigor.

It is too early to predict the adaptability and disease resistance of these new hybrids. Test plantings to date indicate that their early growth rate is extremely promising. Frostcrack and sunscald observed on some of the hybrids indicate the need for continued testing for climatic hardiness. At present the chief risk with these hybrids appears to be disease, which will be discussed under that heading.

In 1950 the Match Company built greenhouse and nursery facilities at Mykinge, similar to those in Denmark, for the commercial production of aspen hybrids; the initial production goal was 200,000 hybrid seedlings per year. The hybridization work is started in February in greenhouses equipped to provide additional light to hasten the development of flowers and seed. The seed ripens and is planted approximately 3 weeks after pollination.

The Netherlands.—Poplar breeding is a major project of the Forest Research Institute in Wageningen, under the direction of Dr. H. van Vloten. The breeding techniques used at the Institute stem from, and are basically similar to, the methods used for experimental poplar breeding in Denmark and Sweden.

Male branches, in water, are placed in small glass-partitioned chambers in a sun porch of the laboratory building and the pollen is permitted to shed. Female branches are bottle grafted on 1-year-old rooted cuttings in pots. During the growing season these pots are plunged outdoors, but the plants are lifted periodically to prevent the roots from growing out into the soil. Kept root-bound, the plants—aspens particularly—will bloom for several successive years. On Leuce poplars, pollinations are also made on flowering branches that are kept in water until the seed matures.

Before and after pollination the female grafts and flowering branches are given artificial illumination between 5:30 p.m. and 7:30 a.m. to hasten flowering and seed maturation (fig. 10).

BOSBOUWPROEFSTATION T. N. O. photo

FIGURE 10.—Control-pollinated bottle grafts maturing seed on greenhouse bench at the Forest Research Station, Wageningen, The Netherlands. These potted plants are given additional artificial illumination during the night to hasten seed maturation.

Special pollination chambers, constructed of glass and aluminum and slightly larger than a telephone booth, are arranged along the sides of the greenhouse (fig. 11). They are heated by steampipes along the wall and are connected at the top to an exhaust ventilating system. The temperature of the chambers is maintained at 20° to 22° C. If the temperature rises too high, the ventilator is turned on and cool greenhouse air is drawn into the bottom of the chambers.

Several female parents are brought into a chamber just before the first flowers are receptive and are pollinated each day as the successive flowers in the maturing catkins become receptive. Pollen from one tree only, or from a single clone, is used in each chamber. When the pollinations are completed, the female catkins are washed with a fine water spray and the potted plants are returned to the greenhouse bench. Each pollination chamber is thoroughly washed down before another set of pollinations is started.

The control-pollinated seeds are planted individually on thin blocks of pressed peat that are thoroughly soaked in water before use. After planting, the blocks are kept in a glass-covered greenhouse bench. The germinated seedlings are lifted from the peat blocks after about 7 days and are transplanted to seed pans or flats that contain a thin surface layer of heat-sterilized soil. This method, seen only in The Netherlands, is said to eliminate loss

BOSBOUWPROEFSTATION T. N. O. photo

FIGURE 11.—Pollination chambers in the greenhouse of the Forest Research Station, Wageningen, The Netherlands.

from damping-off. The seedlings are given artificial illumination between 5:30 p.m. and 7:30 a.m. until they are potted and placed in coldframes.

Many progenies from crosses in the Leuce and Aigeiros poplars were growing in the nursery in 1952. The poplar breeders in The Netherlands, as in all other countries, were faced with the problem of finding land for plantation tests of the large numbers of seedlings that are relatively easy to obtain from controlled breeding.

Great Britain.—The earliest controlled breeding work with poplars was done by Augustine Henry in 1912 and 1914. His best-known poplar hybrids are the clonal mixture that he named *P.* ×*generosa*, F_1 hybrids between *angulata* × *trichocarpa*. There has been no recent controlled breeding with poplars in England.

Germany.—Poplar breeding on a comprehensive scale was started by Dr. W. Wettstein in 1930. Although this project was a casualty of World War II, a plantation of Wettstein's hybrids—now more than 17 years old—near Frankfurt includes some excellent individuals that have been selected for clonal testing.

The most extensive controlled-breeding program in West Germany is centered at the Federal Forest Genetics Research Station in Schmalenbeck near Hamburg. Although emphasis has been on the breeding of the Leuce poplars, work has also been started on Aigeiros poplars. Controlled breeding with the Leuce poplars includes breeding with triploid aspen, intraspecific crosses between selected phenotypes, interspecific hybridization, and since 1954 a breeding project with triploid *P.* ×*canescens*. A major concern is to decide how large a progeny should be outplanted for future selection and to find sufficient suitable land for plantation tests.

Limited controlled breeding has been done by other German workers. At Harsefeld, in Lower Saxony, Forstmeister H. Lücke has made some crosses and has been attempting to produce polyploids by colchicine treatment. Prof. Rohmeder, in Munich, has progeny from a cross between *P.* 'Marilandica' (female) and 'Italica' (male).

Austria.—Since the end of World War II Dr. W. Wettstein, at the Federal Forest Research Station in Hadersdorf (Vienna), has been breeding Leuce and Aigeiros poplars. Breeding and selection for photoperiodic response is considered particularly important because early spring budding and delayed fall dormancy are the most serious hazards at the higher elevations in Austria. Controlled breeding is done on flowering branches brought into the greenhouse and pollinated during January and February—the method devised by Wettstein in his early work in Germany. Approximately 10,000 seedlings were produced in 1956, including crosses with pollen from Spain and Korea.

Belgium.—The Poplar Experiment Station of the Belgian Match Company, established and specially designed for poplar breeding, has excellent laboratory and greenhouse facilities, including pollination chambers, and a good nursery site. The breeding techniques used by Dr. C. Muhle Larsen, Director of the Station, are essentially the same as those described for The Netherlands. The breeding work is still in its early stages. The major objectives are intraspecific and interspecific breeding to obtain improved clones for commercial use, and basic genetic information on various taxonomic and physiological characteristics.

France.—In the poplar nursery of the Match Company in Saintine, Mr. Chardenon is growing 27 seedlots of American poplar species for future breeding work. They have also been experimenting on the grafting of flowering scions of Aigeiros hybrids from old trees on rootstocks in small pots. These have been treated in the same manner as aspen grafts in Denmark, Sweden, and The Netherlands. The oldest grafts were 3 years old in 1952 and all had failed to bloom after the first year. They have also grafted scions of black poplar hybrids on willow as a possible method for getting partially incompatible grafts that might bloom at an early age.

Intraspecific and interspecific breeding with aspens and white poplars was started in 1954 by the National Forest Research Station at Nancy. The aspen hybridizations include crosses with pollen of *P. tremuloides* and *P. grandidentata* from Canada.

Italy.—A limited amount of controlled breeding is done every year at the Institute for Poplar Research at Casale Monferrato with Italian pollen and pollen from other countries. Tetraploid pollen has also been used. Exceptional conditions that favor natural hybridization throughout the Po Valley have made available seed and seedlings in almost unlimited quantity from parents that have been subjected to severe natural selection resulting from the prevalence of epidemic diseases. Consequently, only about 2 percent of the clones under test by the Institute have been obtained from controlled pollinations. Most of the clones have been derived

from naturally pollinated seed collected from superior phenotypes. Several seedlings, from seeds received from our lower Mississippi region, are considered to be very promising. In 5 years, one of these (clone 72/51) had grown to a diameter of 13 inches at 3.3 feet above the ground.

Spain.—Controlled breeding with Aigeiros hybrids ×*P. nigra*, *tremula* × *alba*, *tremula* × 'Bolleana,' *tremula* × *nigra*, and *alba* × *nigra* has been started since 1953 at the Forest Research Institute in Madrid. Breeding is directed toward rapid growth, improved wood quality for veneer, lumber and pulp, and disease resistance. All progenies derived from controlled breeding are tested in the nursery in Madrid and the most promising are then used in field tests.

Significance for the United States

The possibilities for selection of natural hybrids are limited in the United States because exotic species or hybrids have seldom been used in commercial plantations. Exotic species have been planted in botanical gardens, arboretums, and—to a very limited extent—as shade trees. Although the older European hybrids have been extensively planted as street and shade trees, male clones were used almost exclusively because the female trees produce objectionably large amounts of cottony seed.

Natural hybridization has undoubtedly occurred where such European hybrids have been planted within the pollination range of our native poplars. But the germination and survival of such hybrid seed and seedlings would depend on a combination of favorable site conditions that are seldom present in residential areas where poplars are planted as shade trees.

Our native species, *P. deltoides*, *P. trichocarpa*, and *P. tremuloides*, three of the best timber poplars in the world, merit intensive racial studies and clonal selection and testing. Select clones can be used for planting until tested hybrids are available, but their principal value will be as parents for controlled breeding and hybridization.

The best of the European and Asiatic poplar species, those that have proved to be resistant to European diseases and insects, should be introduced and tested in different regions of the United States for possible use in practice and future breeding. They should be imported by means of seed, not cuttings; it is impractical, if not impossible, to sample adequately the inherent variation within an exotic species by the importation of cuttings.[3] If possible, seed should be obtained from 5 to 10 trees selected at random in each of a sufficient number of localities to sample the entire range of a species. This would provide information on possible racial variation as well as on individual variation.

Clonal tests must be set up in comparable, statistically sound, field designs under a wide variety of environmental conditions be-

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[3] Poplar cuttings can be imported only through the Division of Plant Introduction and must be grown in quarantine at the Plant Introduction Garden for 1 or 2 years before they are released.

fore individual clones of native species or new hybrids can be recommended for commercial planting. The excellent growth and form of the selected ortet, substantiated only by nursery performance of the ramets, is not an adequate clonal test.

A central clonal nursery, a "clone bank," is needed to supply the demand for certified cuttings for nationwide tests. Only clones that have been adequately tested and found superior in at least the locality of their origin—and only the very best foreign clones, including those with figured wood—should be accepted and grown in such a central clonal nursery.

We need many demonstration poplar plantations, similar to those established by the German Poplar Society, to bring the poplars best adapted to a region or locality to the attention of farmers and landowners.

Controlled breeding and hybridization with our best native species should be started or expanded in the South and West because we do not yet have the possibilities for extensive natural hybridization. Large progenies of known parentage can be obtained easily through controlled breeding. Such progenies should be outplanted for selection of the best ortets for clonal tests after 10 to 15 years.

Aspen hybridization deserves special attention where the native aspen is at present commercially important or where it is better adapted to reforestation than other native species. If aspen hybrids prove to be as promising in this country as in Europe, it is quite certain that their mass production as F_1 hybrids would also be economically feasible in the United States.

NURSERY PRACTICE

European poplar nurseries are invariably on good agricultural soils, and most nurserymen practice a rotation that allows an interval of 2 to 5 years between successive poplar plantings. Organic manuring, direct or by cover crops, and the use of mineral fertilizers where necessary, is standard practice. Irrigation is considered essential in many nurseries. Spraying for insects and nursery diseases is practiced in all countries. Crooked trees are often staked because only straight stems can be certified for sale where certification is in effect. Where leaders are lost or damaged, laterals may be tied to vertical splints to obtain straight stems.

Pruning of nursery stock is not uniform in any country. The most common practice is to prune to a single whip by removing all side branches just before or immediately after the trees are dug for sale.

A traditional and common practice in some parts of Germany and France is to remove all side branches except three or four of the strongest laterals of the current year's growth. These lateral branches are cut back to short stubs 2 to 8 inches long (called Zuchtruten in Germany), which may be removed in the second year after planting. This heavy pruning is advocated to hold back top growth during the first year in order not to overtax the temporarily reduced root system. Some of the most progressive Ger-

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man nurserymen prune trees for roadside planting as above, but prune trees for forest planting to only one-third or one-half their height.

In The Netherlands, 1-, 2-, and 3-year stock is generally pruned progressively during the last year in the nursery to avoid retarding growth and to obtain rapid callusing. The trees are pruned to one-fourth their height in early spring, to one-third in June, and to about one-half in the fall before they are dug for sale. Some nurseries in France, including the Cacor State Poplar Nursery, are pruning their trees progressively during the growing season to approximately one-half or two-thirds of the stem height. Pruning stumped trees to one-half their height is recommended and practiced in Italy and in England.

Aigeiros Poplars

The black poplars, cottonwoods, and their hybrids are commercially propagated by cuttings and less commonly by sets. Cuttings are usually 10- to 15-inch lengths of dormant 1-year-old stems. Sets are dormant whips, 4 to 10 feet or more in length—most frequently 6 to 8 feet, taken from nursery stools, pollarded trees, or the top branches of felled trees. They are usually 1 or 2 years old, but may be older where they are taken from the upper branches of mature trees. Although sets are most often used directly for outplanting, a few nurseries produce 1-year-rooted stock from 1-year-old sets that are 3 to 6 feet long and are planted 10 to 18 inches deep.

Throughout most of the poplar regions of Europe, cuttings are obtained from stools, spaced 3.3 by 3.3 feet to 4.5 by 6.5 feet apart, that are usually cut back to 2 to 12 inches above the ground. Some growers prefer higher stools (up to 3 or 4 feet) for easier cultivation and handling. The current growth, cut back to the stool each winter, is used for cutting stock.

Stooled plants, with their many stubs, tend to accumulate such facultative parasites as *Valsa* and *Dothichiza*, and also boring insects. The buildup of diseases and insects in stools varies from nursery to nursery, depending on the cultivar, climate, site, and nursery practice. This has led to wide differences of opinion about the effective life of a stool planting; estimates range from 4 to 15 years or more. Loss of vigor of the stools is generally attributed to the annual harvesting of the shoots rather than to facultative parasites. In all cases that came to my attention, the early decline in vigor was most probably due to the inroads of *Valsa*, *Dothichiza*, wood and bark borers, and other diseases or insects.

In Baden, Germany, Dr. Bauer is testing the possibility of maintaining healthy stools by very careful trimming of pollards 3 feet high to promote rapid callusing of smooth, rounded heads without projecting stubs (fig. 12). In some of the Baden poplar nurseries the weaker shoots are removed from the stools in early summer to force the stronger shoots into better height and diameter growth.

Photo by F. BAUER

FIGURE 12.—Production of cuttings on 3-foot-high pollards in one of the state poplar nurseries, Baden, Germany. The current growth is removed annually for cuttings or sets. The tops of the stools are very carefully trimmed to promote rapid callusing of smooth, rounded heads without projecting stubs.

There has been much emphasis in Europe on how cuttings should be made, stored, and planted. Many nurserymen and poplar experts claim that a good cutting must be cut at an angle, not transversely; that the upper cut must be immediately above a bud; and that the cuttings must be made with a sharp knife because pruning shears make inferior cuttings.

Cuttings (figs. 13, 14) are generally made during the winter, tied in small bundles, and stored in moist sand in a storage cellar, heeled-in in light soil, or buried in pits until planting time. Some growers insist that cuttings should be stored vertically with the butt ends up. There is difference of opinion as to whether cuttings should be callused before planting.

Length of cuttings varies from 9 to 15¾ inches, with 9¾ to 11¾ inches the most common length where cuttings are planted flush with, or very slightly below, the surface of the soil. As soon as there is sufficient growth, all but one shoot is removed and the soil is hilled-up slightly over the top of the cuttings. This deep planting, presumably to decrease the possibility of disease infection (a doubtful control measure) and to favor growth of the top bud, is widespread but not universal.

Many nurseries in France plant the longer cuttings, 11¾ to 14¾ inches long, with two or more buds above the ground. The Raverdeau Nursery and the match company nursery at Saintine have been planting 13¾-inch cuttings with 3 or even 4 buds above

GREAT BRITAIN FORESTRY COMMISSION photo

FIGURE 13.—Type of cuttings recommended by the Forestry Commission of Great Britain.

Photo by FERNANDO JAIME FANLO

FIGURE 14.—Poplars at the end of their second season's growth from cuttings, in the state poplar nursery at Castelnov on the Martin River, Province of Teruel, Spain. Average height at the end of the first year was 9 feet.

ground. In June the cuttings are pruned to one good shoot, usually one from a lower bud. On cultivars like *Populus* 'Regenerata,' which have a tendency to spreading growth, the young shoot is tied to the top of the cutting to obtain straight-stemmed trees.

Nursery spacing of cuttings varies greatly. Where the rooted cuttings are lifted and replanted at the end of 1 year, close spacing is the rule. In Italy they are planted 3 to 4 inches apart in rows spaced 32 to 40 inches. In northern Europe, cuttings may be spaced as close as 6 to 8 inches in rows 19½ inches apart. In The Netherlands the 1-year rooted cuttings are then lined out 3.3 by 3.3 feet and are grown for 1 or 2 years at this spacing. Spacings of 15½ by 31½ to 40 inches are used in northwestern Germany for the production of 2-year stock without transplanting. In France the spacing for cuttings that will be dug as 2-year-old trees is usually 15½ to 19½ inches by 3.3 feet.

Disease conditions have been so serious in Italy that stool plantings are now seldom used for the production of cuttings. The recommendation of the Poplar Research Institute at Casale Monferrato that stumped trees be used for outplanting has been widely accepted. The stumped-tree system eliminates the hazard of infected stock from diseased nursery stools and saves the nursery space and labor required to maintain stool plantings.

Stumped plants are produced by cutting back 1-year-old trees to a short stump with two or three buds, close-pruning the roots, and replanting the stumps in nursery rows. The stumped plants (fig. 15) are planted level with the ground and are spaced 16 to 24 inches in rows 5½ to 7 feet apart. When the stumps have sprouted and the new shoots are 10 to 12 inches high, they are pruned to one shoot and are hilled to cover the stump.

Cuttings are made from the stems of the 1-year-old trees from which the stumped roots are obtained. The cuttings are planted with their tops at ground level, and after growth has started the soil is slightly hilled around the shoots to cover the top of the cutting. Cuttings are spaced 3 to 4 inches in rows 32 to 40 inches apart; or to conserve space, they may be planted in single rows between the rows of stumps.

At the end of the year, the 1-year rooted cuttings are dug, cut back, and replanted as stumped trees and cuttings. The rooted trees are dug and sold as 2+1 stock (2-year root, 1-year top) if they have grown to sufficient size; otherwise they are left another year to produce 3+2 stock up to 24 feet in height. The demand is heavy for large trees because their use usually brings the grower a better financial return.

Some Italian planters who raise their own nursery stock on extremely fertile soils use the largest of their 1-year-old trees (8 to 10 feet tall) for outplanting and get satisfactory results. Large 1-year trees are also sold by commercial nurseries where there is a heavy demand for planting stock, but this practice is not recommended by the Poplar Institute.

GREAT BRITAIN FORESTRY COMMISSION photo

FIGURE 15.—Stumped 3+2 (3-year root, 2-year top) ready for outplanting. Kennington Forestry Commission Nursery, England.

Leuce Poplars

Populus alba, the European white poplar, is usually propagated from cuttings or sets in the same manner as the Aigeiros poplars.

The gray poplar *P.* ×*canescens* represents a confusing mixture of natural hybrids between *P. alba* and *P. tremula*, and undoubtedly includes many generations of crosses between hybrids and backcrosses to both parents. The rooting ability of these hybrids varies, but few clones root well enough for commercial propaga-

tion from cuttings. Where there is demand for the gray poplars they have usually been propagated from root suckers, root cuttings, or by layering rooted stems in a shallow trench with the tip exposed. By this method most of the buds develop shoots that root around the bud and can then be cut into separate plants at the end of the growing season.

W. Gröhn, a nurseryman in Halstenbek, Germany, stated that he had good success in rooting gray poplars by grafting short willow cuttings to the base of the poplar cutting before planting. Both the willow cutting and the poplar cutting produce roots. When the trees are dug, the willow cutting is simply broken off, leaving a well-rooted poplar.

P. tremula, the European aspen, is usually grown from seed. In the very few places where aspens are propagated vegetatively, the commercial nurserymen use root suckers, root cuttings (fig. 16), or layers, as for the gray poplars.

Photo by W. WETTSTEIN

FIGURE 16.—European aspen propagated from root cuttings. Short pieces of root are planted vertically or horizontally. Wettstein, in Austria, reports up to 60 percent rooting, with great variation between individual trees.

Aspens and gray poplars can also be successfully rooted by the "RS-cutting" method developed by C. Muhle Larsen. In late February pieces of root 2 to 4 inches long are placed in moist

peat moss, lightly covered, in a greenhouse or hotbed. By the end of March, the root pieces have produced softwood shoots. Aspen is more prolific than gray poplar; one 4-inch length of aspen root produced 38 shoots. The 1- to 2-inch shoots are removed during April and May and are rooted in clean gravel in the greenhouse, hotbed, or coldframe.

The *P. tremula* × *tremuloides* hybrids are grown from mass-produced hybrid seed. At the Hellestrup nursery in Denmark, the hybrid seed is sown in outdoor beds on 2 to 3 inches of thoroughly composted soil that has been steam sterilized in the beds at 100° C. for ½ hour with portable equipment. Damping-off has not been serious. Sowing is at approximately 1 gram of seed per 4 square meters (44 square feet) of bed. At this density of sowing they can expect approximately 1,000 one-year-old seedlings.[4] The seed is covered lightly with composted soil and the beds are covered with glass for about 1 month. Past practice was to shade the beds during summer, but in 1952 the nursery experimented without shades to obtain stouter seedlings.

The 1-year seedlings are transplanted during the fall and early spring to nursery rows spaced 12 inches apart with 24 inches between every third and fourth row. This spacing is adapted to the tillers used for cultivation. The nursery is on a soil that has high pH and is underlain with chalk.

At Mykinge Försöksgård, Sweden, mass production of hybrid aspen begins in early February. The seed is sown on sphagnum moss litter in greenhouse seedbeds about 3 weeks after pollination. By early June the hybrid seedlings, 2 to 4 inches high, are ready for transplanting to outdoor beds. All seedlings are lifted in the fall and stored indoors in sand during the winter. The largest 1-year seedlings are sold in the spring and the smaller trees are planted in transplant rows to be sold as 1–1 stock.

Significance for the United States

In general, the excellent nursery practice used for the production of poplar planting stock in Europe is applicable to poplar culture in the United States.

Care and precision in making cuttings (angle of cut, knife vs. shears) and in storage of cuttings are not necessary. Between 1928 and 1932, in our work with poplar in the Northeast, we found that we could obtain practically 100-percent survival (without increasing the hazard of disease infection) by cutting bundles of whips into cuttings on a fine-tooth circular saw. We have stored cuttings successfully in all positions—horizontally, vertically, with tops up and tops down; in moist sand; in peat moss; and in sawdust at temperatures from 20° to 34° F., sufficiently low to prevent the production of roots or bud bursting before planting. We have

[4] It has been estimated that 540 grams of hybrid seed will produce approximately 400,000 one-year seedlings and 200,000 salable 1–1 seedlings. The smallest seedlings are discarded.

also found that callusing does not increase the rooting or growth of clones selected for good rooting ability.

Cuttings 10 to 12 inches long are the most practical for nursery planting in the United States.

Nursery spacing of 12 to 18 inches by 2 to 3 feet is generally sufficient for the production of 1-year-old rooted cuttings, 18 to 24 inches by 3 feet for stumped 2+1 stock, and 2 by 6 feet for stumped 3+2 stock.

Planting cuttings just deep enough to leave two buds exposed is preferable to planting level with the ground because this permits easier machine cultivation with a minimum of injury to the cuttings early in the season. There is no sound evidence that deep planting will prevent disease or produce straighter trees. Treatment of cuttings with an effective fungicide will give much better control of disease than deep planting, and straightness of stem depends primarily on the inherent nature of the clone. Some clones must be pruned early to a single stem; others produce a straight stem without pruning.

The Italian practice of using stumped trees for outplanting and of producing cuttings from the 1-year-old trees deserves strong recommendation.

The careful hand labor in making cuttings and the cost of splinting and staking in the nursery to produce straight trees cannot be justified in this country. Extremely crooked trees should be discarded; slightly crooked trees of inherently straight-stemmed clones will straighten up after outplanting.

Vegetative propagation of white poplars and aspens by present European methods, which are barely feasible economically even in Europe, cannot be recommended for commercial use in this country. It should be possible to produce *P.* ×*canescens* hybrids that will root from cuttings under nursery conditions by backcrosses to *P. alba* parents that have good rooting ability.

Hybrid aspen seedlings could be produced commercially in the United States by the method used in Denmark, but minor modifications would be needed to permit use of our standard nursery equipment.

SITE AND SOIL REQUIREMENTS

Aigeiros Poplars

These poplars are generally considered bottom-land species, and relatively few foresters or growers in the past have dared to recommend or try commercial culture on upland sites. But in all European countries, and in America, Aigeiros hybrids have been freely planted on upland sites as shade or roadside trees. In Spain particularly, European black poplars of both pyramidal and spreading types have been grown for centuries along roadsides seemingly too dry for their survival. Growth is very slow but the trees survive for many years under extremely adverse conditions.

Where soil depth, fertility, pH, and moisture conditions are adequate, the growth of Aigeiros poplars on such upland sites is as good as on bottom lands. And conversely, on bottom-land soils of low fertility, low pH, or poor aeration, the poplars grow as poorly as on infertile or dry upland soils. European poplar plantations clearly demonstrate that the limiting soil factors for profitable poplar culture are depth, fertility, pH, moisture, and aeration.

Soil depth

The Aigeiros poplars require soils 2 to 3 feet deep or more for their maximum growth. In general, the minimum depth on which reasonably satisfactory growth was observed in European plantations was approximately 18 inches. There were occasional exceptions, along rivers where the water was reported to be rich in nutrients, where growth was very good on such relatively shallow soils. The soil depth available for the growth of poplars may be limited by bedrock, hardpan, heavy clay, or stagnant ground water. Moving, well-aerated ground water in river bottoms or on slopes does not limit soil depth for the growth of poplars.

Soil fertility

Research on the fertility requirements of poplars has been started in many places, but the work is too recent to provide an accurate measure of the fertility level required for profitable poplar culture. Observations on many European plantations indicate that the most profitable growth rate requires a level of soil fertility equal to that needed to grow a profitable corn crop in the United States. The excellent growth of poplars on river sandbars does not contradict their need for fertile soils. Such trees are utilizing the fertility of the river water.

The effect that soil fertility has on growth rate of poplars was strikingly apparent in a 7-year-old plantation of clone *Populus* 'I–214' in the Po Valley in Italy. This planting was established on a river bottom site with a soil gradient, along the rows, from fertile sandy silt to coarse gravel. Here the same clone varied from 15 inches d. b. h. on the fertile silt to 6 or 7 inches d. b. h. on the less fertile gravel. There apparently was not sufficient variation in pH, permeability, and depth of the water table on this relatively flat site to account for these growth differences.

Soil pH

Liming experiments on a well-drained upland site at the Forschungsstelle für Flurholzanbau in Reinbek, Germany, have demonstrated that on their soils the critical pH for poplar is 4.5 to 5.0. These experiments were based on the growth of nursery stock on land cleared of a beech forest where the pH was originally 3.5 to 3.8. Below pH 4.5, growth was extremely poor; at pH 5.0 growth was fair: but for maximum growth the site required liming to approximately pH 6.0.

Low pH is seldom a limiting factor in the commercial poplar regions of Europe because most of these river-bottom soils are above pH 5.5. The threshold of pH 4.5 to 5.0 is strongly indicated but not confirmed on the relatively few sites with low pH where poplar has been planted in Europe. Unfortunately, heavy soils and poor drainage complicate the interpretation of poor growth on practically all such acid sites.

For example, the clonal test plot of the Netherlands Land Reclamation Society near Zwolle is on polder land where the depth of the water table is kept constant at approximately 20 inches. The soil is a highly organic sandy clay (30 to 50 percent clay) on peat. The soil is 20 inches deep at one side of the test plot and grades to a depth of 12 inches at the other side. The pH varies from 4.2 to 5.2. Although the soil is considered moderately heavy, there appears to be little water movement and inadequate aeration. Growth of the certified Netherlands clones is extremely poor and all clones are infected by bacterial canker. On this site it was not possible to separate the effects of low pH and poor aeration.

Soil moisture and aeration

The Aigeiros poplars require a moist soil during the entire growing season, or a water table within reach of the roots. There are examples of good plantations on sites with light, relatively dry soils where the summer water table is reported to be 12 to 15 feet deep. On upland sites, the best growth was observed more often on medium heavy soils, apparently because their water-holding capacity is better than that of light-textured soils.

Soil aeration during the active growing season is essential. The Aigeiros poplars will grow well on sites that have high ground water if the topography and a light soil permit free water movement to provide aeration. Heavy impervious soils on wet sites, and light permeable soils with a stagnant water table that does not drop below 18 inches during the growing season, are unsuitable.

The Chautagne plantations near Aix-les-Bains, France, present an excellent example of the poor growth of poplar on wet sites where there is insufficient ground-water movement to provide adequate aeration. Approximately 1,700 acres of marshy land below the outlet of the lake were purchased by the government in the late 1930's, drained, and planted with poplar. The soils, pH 7.0 to 8.0, vary from deep silty clay alluvium to stratified layers of peat alternating with thin layers of clay and silt. The drainage ditches originally installed were too shallow and too widely spaced. Much of the area carried a heavy growth of reed (*Phragmites communis*) in 1952.

Three-year-old rooted trees were originally planted at 13- by 16.5-feet spacing without site preparation and without cultivation after planting. The stock was mostly *P.* 'Robusta' with a limited mixture of other cultivars of the 'Virginiana,' 'Regenerata,' and 'Serotina' types. The growth of all cultivars on the poorly

drained silty clay soils has been unsatisfactory, and on the peat soils without site preparation most of the poplars have failed to survive. 'Robusta' has shown itself the most poorly adapted to these wet sites. Small "bleeding" spots on the stems, resembling trunk scab, were abundant in these plantations.

In 1950, three experimental plots were laid out in the 1939 plantation on deep, moderately heavy, silty clay, and were given the following treatments: (1) control, (2) calcium nitrate fertilizer applied annually, and (3) thinning to half the stand by cutting out every other tree. Annual increase in circumference 2 years after treatment indicated no significant benefit from fertilizer or thinning. This tends to confirm the conclusion that the principal deleterious factor in these plantations was insufficient soil aeration due to poor drainage.

It was planned to improve the drainage on these sites by increasing the number and depth of the drainage ditches. To make the peat soils (peat with alternating thin layers of silt and clay) more permeable and so to provide better drainage, these areas were to be plowed 2 to 3 feet deep and permitted to lie fallow for 2 years before planting.

There are examples in France, Germany, and the Low Countries of attempts to establish poplars on poorly drained sites by planting the trees on mounds from 6 to 10 feet in diameter and from 2 to 3 feet in height. The author did not see any plantings of this kind where the poplars continued to grow satisfactorily for more than 6 to 8 years. Mounding the soil in a continuous bank along the drainage ditches (Rabattenpflanzung) was observed to be effective on heavy soils where the drainage ditches were not more than 20 to 25 feet apart and the mounds were 1½ to 2 feet high and 4 to 6 feet wide.

Poplars grow poorly on the banks around the rice fields in northern Italy, which are flooded from April to September. Apparently these banks are not wide enough to provide sufficient well-aerated growing space for the poplar roots.

Site-indicator plants

The study of ground-vegetation types as indicators of site quality for the Aigeiros poplars has received considerable attention in Germany.[5] Many of the species recognized in Germany as indicators of good, medium, poor, or nonpoplar sites are native to the United States, have become naturalized or occur locally as adventive escapes that are not sufficiently widespread to be considered naturalized. With one exception (*Impatiens*), all species in the following lists are found in the United States.

Indicators of the best poplar sites.—The most productive bottomland sites are highly fertile, well drained, and well aerated, and

[5] Hesmer, H. (editor). *Das pappelbuch.* Deut. Pappelverein. 304 pp., illus. Bonn. 1951.
Rüskamp, Gustav. *Lohnender pappelanbau.* 88 pp., illus. Dülmen (Westfalen). 1952.

the ground water is within easy reach of the poplar roots. They are usually characterized by the predominance and lush growth of several of the following species:

Circaea alpina L.	enchanters-nightshade	Indigenous
C. canadensis Hill	do.	Do.
Deschampsia caespitosa (L.) Beauv.	tufted hairgrass	Do.
Galium aparine L.	cleavers, goosegrass	Do.
Geum rivale L.	water or purple avens	Do.
G. urbanum L.	large-leaf avens	Adventive
Glechoma hederacea L.	gill-over-the-ground	Naturalized
Impatiens noli-tangere L.	touch-me-not, jewelweed	[6]
Stachys silvatica L.	hedge-nettle	Adventive
Urtica dioicia L.	stinging nettle	Naturalized
U. urens L.	dog nettle	Do.

[6] Listed because our native species are usually indicators of good poplar sites.

Indicators of good poplar sites.—Lowland meadows with a high water table are usually good poplar sites if some of the following species are abundant. These plants indicate good aeration and a summer water table at least 18 inches deep:

Ajuga reptans L.	creeping bugleweed	Naturalized
Athyrium filix-femina (L.) Roth	lady-fern	Indigenous
Circaea alpina L.	enchanters-nightshade	Do.
C. canadensis Hill	do.	Do.
Filipendula ulmaria (L.) Maxim.	queen-of-the-meadow	Adventive
Humulus lupulus L.	common hop	Indigenous
Lysimachia vulgaris L.	garden loosestrife	Naturalized
Myosotis scorpoides L.	forget-me-not	Do.
Ribes nigrum L.	European black currant	Adventive
Scutellaria galericulata L.	marsh scullcap	Indigenous
Solanum dulcamaria L.	bitter nightshade	Naturalized

On upland sites where the water table is below the effective reach of tree roots the following species are indicators of sufficient soil moisture and fertility for good poplar growth:

Circaea alpina L.	enchanters-nightshade	Indigenous
C. canadensis Hill	do.	Do.
Geum rivale L.	water or purple avens	Indigenous
G. urbanum L.	large-leaf avens	Adventive
Impatiens noli-tangere L.	touch-me-not, jewelweed	[6]
Lamium maculatum L.	spotted dead-nettle	Adventive
Stachys sylvatica L.	hedge-nettle	Do.
Stellaria holostea L.	greater stitchwort	Do.

[6] Listed because our native species are usually indicators of good poplar sites.

Loam to loamy-sand soils with deep ground water can be good poplar sites. Some loess-loam soils in northwestern Germany have produced exceptionally high yields of poplar. The following species indicate safe and productive sites:

Asperula odorata L.	sweet woodruff	Adventive
Galium sylvaticum L.	baby-breath, Scotch-mist	Do.
Stellaria holostea L.	greater stitchwort	Do.

Indicators of poor poplar sites.—Where loam to loamy-sands with deep ground water are poorer in structure and deficient in bases they are less suitable for poplar. Sites that will support only

moderate to poor growth of poplar are characterized by a decrease in the above plants and increasing predominance of the following species:

Anthoxanthum odoratum L.	sweet vernalgrass	Naturalized
Holcus lanatus L.	velvetgrass	Do.
H. mollis L.	German velvetgrass	Adventive
Lonicera periclymenum L.	woodbine	Do.
Rubus ideaus L.	raspberry	Naturalized

Sites not suited for poplar.—Common occurrence of the following plants indicates sites that should not be planted to poplar. These plants indicate that the soil is too wet for adequate aeration because of a high stagnant water table, is too heavy and poorly drained, or is deficient in bases:

Carex acutiformis Ehrh.	sedge	Naturalized
Corynephorus canescens (L.) Beauv.	clubawngrass	Do.
Deschampsia flexuosa (L.) Trin.	wavy hairgrass	Indigenous
Eriophorum angustifolium Honckeny	narrow-leaf cottongrass	Do.
Festuca ovina L.	sheep fescue	Naturalized
Iris pseudacorus L.	yellow iris	Adventive
Milium effusum L.	millet-grass	Indigenous
Molinia caerulea Moench	moorgrass	Adventive
Phalaris arundinacea L.	reed canary-grass	Indigenous
Phragmites communis Trin.	common reed	Do.
Pteridium aquilinum (L.) Kuhn	bracken	Do.
Sphagnum acutifolium Ehrh.	sphagnum moss	Do.
S. cuspidatum Ehrh.	do.	Do.
Vaccinium myrtillus L.	whortleberry	Do.
V. vitis-idaea L.	mountain-cranberry	Do.

Leuce Poplars

The natural range of the European aspen (*P. tremula*) extends from Italy to northern Sweden, and there is evidence for the existence of races that may differ in their site requirements. The variation between northern and southern races in their response to differences in day length is particularly evident.

Aspen has long been an important component of the native forests for the Scandinavian match industry; yet it is only in recent years that aspen has begun to be planted in these northern countries. Plantation culture of aspen in Europe is still in the experimental stage. Since they can be grown commercially on sites that are too dry or too infertile for profitable culture of Aigeiros poplars, the aspens and their hybrids (including *P.* × *canescens* types) can be used to extend the range of profitable poplar culture. It must be noted, however, that plantations of the so-called "Polish" aspens in Holland and of the hybrid aspens (*tremula* × *tremuloides*) in Denmark indicate that even aspens will make their maximum growth on fertile, moist, but well-drained soils.

The *P.* × *canescens* or gray poplars (the *alba* × *tremula* complex) have been planted throughout Europe, usually as shade trees and windbreaks but seldom for timber production. In northwestern Germany they are preferred for planting near the coast because they can withstand a coastal climate with its wind and salt spray better than other poplars.

The natural range of *P. alba* has not been clearly defined. In localities in southern Europe where the white poplar is abundant and reproduces naturally, it reaches its best development on well-drained fertile bottom lands. Its optimum site requirements are apparently similar to those described for the Aigeiros poplars. Although the white poplar has been widely planted in Europe as a shade and ornamental tree on upland sites, there is no conclusive evidence that for profitable culture it is better adapted to drier or poorer soils than the European black poplar (*P. nigra*).

Significance for the United States

The natural distribution of the European and American Aigeiros poplars along river courses may have been responsible for the traditional notion that these poplars are exclusively adapted to bottom-land sites. This is true for natural regeneration by seed. Bare soil, free from sod and weed growth, and continuous moisture at the soil surface for several weeks at the time of seed germination, are essential for germination and seedling survival. Such conditions are most frequent on river bottom lands that are subject to annual or periodic overflow. They are too infrequent on upland sites to bring the poplars out of the river valleys by natural seeding. But poplar culture is not based on the uncertainty of seed reproduction in such situations; plantations are established with rooted trees or cuttings.

The Aigeiros poplars can be grown commercially on upland soils, but research is needed to provide practical criteria for evaluating sites suitable for their profitable growth in the United States. Such research should include a study of the reliability of common native plants as indicators of site quality.

The guidelines outlined in this section, based on European experience and research, can be safely applied to poplar planting until more specific information is available in the United States. It is safe to assume that most of the indicator plants associated with good and poor poplar sites in Europe would be indicative of approximately the same biological conditions, favorable or unfavorable to poplar, when grown in this country. It is possible, however, that some of these plants may not require the same depth of soil necessary for the best growth of hybrid poplar. Soil depth should be checked on all sites considered for poplar culture.

The European aspen has much the same site requirements as our American aspens. The American species can be used to extend profitable poplar culture in the United States to sites that are not suited for commercial plantations of Aigeiros poplars.

We have only preliminary evidence of racial variation in American poplar species. The evidence of considerable racial differences in the European species indicates the immediate need for intensive racial studies of our important native poplars.

The gray poplars (*alba* × *tremula*) might be used to excellent advantage in breeding for rapid-growing hybrids adaptable to drier upland sites. Crosses between the European *alba* and our American aspens also offer possibilities for obtaining types with

hybrid vigor that would grow on drier and less fertile sites than Aigeiros hybrids require.

With the exception of batture lands of our largest rivers, fertile, well-drained soil for profitable poplar culture is seldom available in large contiguous areas. But on almost every farm there is some acreage that meets the requirements for excellent poplar growth and that is not being used for agricultural purposes. For example, poplars can be grown around barns and farm buildings; they can serve as shade trees and can eventually be cut for timber. With a succession of younger trees to replace those that are harvested, such plantings would have a continuous aesthetic and monetary value. Farm roads and fence rows offer areas for the growing of poplar. Fertile farmland that is too wet in the spring for cultivation, but is sufficiently well drained during the growing season, is normally used for hay or grazing. Planted to widely spaced poplars, such land could produce both timber and grass.

OUTPLANTING

Site Preparation

Intensive soil preparation is commonly practiced only where the land is cropped between poplar rotations or intercropped during the early years after the poplars are planted. Under such conditions the land is plowed, harrowed, and fertilized for whatever crops that are to be grown.

Alder- or brush-covered sites are always cleared before planting, either completely or in wide strips; but there is usually no additional soil preparation. A typical example was observed in France where a match company had cleared an area carrying a dense stand of alder in strips 10 to 13 feet wide on 26.5 feet centers, and had planted the poplars 26.5 feet apart through the centers of these strips. The strips will be weeded for several years by cutting the new alder sprouts. The alder between the strips will be cut for fuel after 5 years, and again after 15 years.

Planting Stock

Unrooted cuttings and sets

The use of unrooted cuttings for outplanting was not observed in any of the poplar regions in Europe. Cuttings are the cheapest type of planting stock, but they require site preparation equivalent to plowing and harrowing and they must be cultivated for at least 1 year. They could be used successfully where the poplars are established on land on which cultivated crops are interplanted for several years. No convincing reason was advanced anywhere in Europe for the exclusive use of sets or rooted trees under such conditions.

Sets are used to only a limited extent in most of Europe, but there are a few localities where they are planted almost exclusively. Sets are always pruned clean of even the smallest side branches.

They are outplanted almost exclusively on sites that have a high water table because it is generally considered essential that the butts be in the ground water. Nevertheless, the author saw a few examples of excellent results with 1- and even 2-year-old sets planted above the water table in soil that was rather wet until early summer.

The oldest clonal tests of the Netherlands Land Reclamation Society were established with one row of rooted trees and one row of sets for each clone. After 20 years there was practically no difference in form or growth rate between the trees derived from these different planting stocks.

In Germany, in Westphalia and the Lower Rhine, 3- and 4-year-old sets, 10 to 15 feet long from pollarded trees, have been used with good results. In the Rhine bottom lands of Baden, sets are being used with excellent results on favorable sites. Here 1- or 2-year-old sets 6 to 8 feet long are used; they are peeled a few inches at the base, and are planted deep enough so that the peeled butt is in the ground water. On the steep face of a strip-mine bank in Horrem, Dr. Müller planted sets to a depth of about 3 feet in the winter of 1950-51. For this sandy fill, survival at the end of the first year was excellent and the growth was fair (fig. 17).

The Forest Inspector for the region of Venice, Italy, told the author that in the spring of 1952 he planted branches (sets) from large trees to a depth of more than 12 feet to reach ground water on a dune site where rooted trees had failed repeatedly. He said that in September of the same year survival of these long sets was better than 90 percent.

In the region of Hostalrich, Spain, the use of sets (plantones) is traditional and apparently the general practice. They are always planted with the butts in the ground water, and survival and growth is excellent. *Populus alba*, occasionally planted in this region, is also grown from sets.

There are some excellent 30- to 35-year-old poplars with breast-high diameters up to 23 inches on the Pratt Estate in England that were said to have been planted as sets in openings in a bottom-land hardwood stand.

Rooted planting stock

Rooted trees are most generally used for outplanting in all European countries, but there is considerable diversity in the age and size of planting stock even in the same locality. Trees less than 5 feet high are seldom used: the demand is predominantly for larger sizes. Rooted stock is of two types: rooted cuttings and stumped trees. Both are graded and priced either by height or by circumference. The grades commonly used in Italy are 8 to 11 cm. (3 to 4.2 inches), 11 to 15 cm. (4.2 to 5.8 inches), and more than 15 cm. in circumference at 1 meter (3.3 feet) above the ground.

Rooted cuttings.—Rooted cuttings are nursery-grown trees that have not been cut back to the ground, so root and top are therefore the same age. They are outplanted as 1-, 2-, and 3- and occasionally 4-year-old trees. In northern and middle Europe 2- and 3-year-old

stock up to 12 feet high is most frequently used, although large 1-year-old rooted cuttings are planted with very good results on favorable sites.

For roadside and windbreak plantings the older 3-year and even 4-year trees have a better chance for survival because of their larger size and sturdier stems. In southern Europe, where poplars are grown on nursery soils of high fertility, 1-year-old rooted trees, 8 to 12 feet in height are used to some extent for outplanting; but, in Italy particularly, most planters prefer the larger, heavier-rooted, and stronger-stemmed 2- and 3-year stock.

Photo by R. MÜLLER

FIGURE 17.—One season's growth of unrooted sets on the steep face of a strip-mine bank in the lignite district west of Cologne, Germany.

Stumped trees.—Stumped trees are rooted cuttings that have been cut back to two or three buds at the end of the first year, root-pruned, replanted and grown 1 or 2 years longer in the nursery. The root is therefore 1 or 2 years older than the top. (See Nursery Practice, p. 33.) Stumped trees have been most extensively used in

Italy, and their use is recommended in England and is increasing in other countries.

In Baden, Germany, the State Forest Service has used stools from which cuttings are normally taken as stumped trees to fill failures in plantations. Roots 2 to 5 years old with 1-year shoots are used, depending on the age of the plantation where fill-ins are required.

Pruning of planting stock

Planting stock is generally top- and root-pruned at the nursery. Depending on the size of the tree, roots are ordinarily cut back to 6- to 12-inch lengths. The degree of top-pruning (described under Nursery Practice) varies from none to complete removal of all side branches and sometimes even to cutting back of the leader.

Observations in many young plantations indicate that severe pruning may retard early growth. The first- and second-year growth of some 20 clones that were planted without pruning in the poplar arboretum near Koblenz was remarkably better than that observed on any heavily pruned stock established by comparable methods on similar sites in central and northern Europe.

Spacing

The spacing of poplars in rows and particularly in plantations is one of the most controversial aspects of European poplar culture. The traditional conviction is that the cultivated poplars are biologically unlike forest trees in that they cannot be grown in forest stands. But from a biologist's standpoint it is poplar culture that differs basically from general forest practice because poplar plantations are usually monoclonal stands composed of genetically identical ramets. There is thus a complete lack of the genotypic variation that exists in a natural stand or in a plantation established with seedlings.

Row spacing

Poplars, except the aspens, are extensively planted in single or double rows along public roads, farm roads, field boundaries, and fence rows. Double-row planting, two relatively close-spaced rows with the trees staggered in the adjacent rows, is less common than single rows.

Many experts and growers recommend that poplars planted in single or double rows should be spaced widely enough apart to avoid contact between mature crowns, or should be thinned as soon as the crowns touch. This criterion permits very close planting of narrow-crowned trees such as the Lombardy poplar, and necessitates relatively wide spacing of broad-crowned types. This practice tends to ignore completely the probability of deleterious root interactions between adajacent trees. There is evidence that the growth of poplar may be more seriously influenced by the soil volume available for free development of the individual root system than by top competition for light.

Row plantings can be found in Europe at almost every conceivable spacing from practically open-grown trees to spacings as close as 3 feet. There is little evidence of seriously retarded growth vigor where closely spaced row plantings are on deep, fertile soil and the tree roots are not limited in their lateral extension by deep ditches or other obstructions. Retarded growth was observed in closely spaced row plantings on shallow soils—where depth was limited by the water table or infertile or impervious subsoil—and where the sidewise extension of roots was curtailed by water-filled ditches.

Close spacing of trees in rows, or double rows, does have a serious effect on log quality for lumber and veneer. Insufficient room for normal concentric crown development results in leaning trees that produce crooked logs with eccentric boles. Such trees may also have a large amount of tension wood, which further degrades their value for high-quality lumber and veneer.

Plantation spacing

There is relatively little argument about the spacing of aspens. They are traditionally considered to be forest trees than can be grown at relatively close spacing. The biological factors that affect closely spaced monoclonal plantations are not operative in aspen plantings because seedling stock is generally used for outplanting. In the Scandinavian countries the aspen hybrids are usually spaced approximately 10 by 10 feet with alder or other filler trees. The somewhat higher cost of the hybrid planting stock apparently has a bearing on plantation spacing.

Throughout Europe, plantations of Aigeiros poplars and their hybrids are established at almost every conceivable spacing, including square spacings of 5.0, 6.6, 9.8, 13.3, 16.4, 19.7, 23 and 26.3 feet, and rectangular spacings of 13.3 by 32.8 feet, 23 by 32.8 feet and 26.3 by 29.5 feet. There is wide divergence of opinion on plantation spacing, at the local as well as at the international level. Unfortunately the arguments for close or wide spacing are often seriously confused by failure to distinguish between the biological and economic aspects of the problem. Present planting distances are largely the product of tradition and of observations on the growth of poplar cultivars that are assumed to be genetically identical and are growing on sites that are assumed to be similar.

There are two rather adamant schools of thought on planting distance in Germany. The advocates of wide spacing (20 by 20 feet to 26 by 26 feet) argue that poplars should be planted at their final (crop-tree) spacing to produce high-quality logs for veneer and lumber, and pulpwood from the tops and branches. Such wide planting eliminates the hazard of stand degradation because of delayed thinning due to negligence, labor shortage, or lack of good markets for pulpwood. Spacing as close as 6.5 by 6.5 feet, with early and regular thinning, is urged by those interested in pulpwood production; but the relatively high establishment costs and the low value of the first thinnings for pulpwood tend to discourage such practice. Studies in The Netherlands

indicate that the pulpwood value of a 6- to 8-year-old tree is less than the per-tree establishment costs.

The most commonly recommended spacings in Europe are from 20 by 20 feet to 26.5 by 26.5 feet. In Italy, there is increasing use of the 25.5-feet triangular spacing (trees staggered in adjacent rows) recommended by Prof. Piccarolo, and this spacing is gaining in favor in some other countries. Although the demand for pulpwood was the principal stimulus for the early interest in poplar culture in Italy, the expansion of markets for other uses has affected the trend in spacing. In 10 to 14 years, with wide spacing, the Italian grower can produce trees with 70 to 75 percent of their merchantable volume salable for lumber and veneer, and 25 to 30 percent marketable as pulpwood.

In Austria, Dr. Wettstein recommends spacing the poplars 13 by 20 feet where they are planted in mixture with other light-demanding species. For pure plantings of poplars where there is a pulpwood market, he is considering 6.6 by 6.6 feet, with early thinnings to 13 by 13 feet and a final spacing of 26 by 26 feet. Thinnings in 6-year-old experimental plantations established at the 6.6- by 6.6-feet spacing have yielded 1,120 cubic feet per acre of pulpwood, approximately 12 cords.

In widely separated parts of Europe, spacing 16.4- by 16.4-feet has given excellent yields without thinning. In Baden, Dr. Bauer recommends this spacing with filler trees at the same interval. The recommendation is justified by past experience; this planting distance with fillers has been widely practiced in the bottom lands of Baden for many years. The 16.4- by 16.4-feet spacing has also been in general use in southeastern Spain, where the plantations are intercropped during the first 4 or 5 years. The recommended 15- by 15-feet planting distance in England is not based on firm local experience, but it falls within this middle spacing range.

Planting

There is more agreement on planting methods than on almost any other aspect of European poplar culture. Correct and careful planting is strongly emphasized everywhere. Depending on the size of the stock, planting holes are made 16 inches to 3 feet in diameter or 16 to 24 inches square, and 16 to 24 inches in depth. The use of tractor-mounted soil augers to dig planting holes 12 to 24 inches in diameter is being tested in several countries. They are highly efficient where the soil is not too rocky.

Use of organic or mineral fertilizers, mixed with the soil in the planting hole, is strongly recommended but is not yet common practice. It depends on the fertility of the soil and the affluence of the landowner. Fertilizer is usually applied as a "small" or "large" handful. On land that is intercropped for the first few years, the fertilizer is applied as a part of the crop culture. Manure or mineral fertilizers are seldom used where poplar plantations are on meadowland that is cut for hay or used for grazing. Such lands are most often river bottoms subject to annual overflow, where fertilization is seldom necessary.

Some poplar foresters recommend annual or periodic fertilization on sandy soils of low fertility. Research on this problem has been started in Germany, but there is at present very little information to guide the grower as to the kind and quantity of fertilizer required.

Liming is considered essential for soils with a low pH and is widely practiced in some regions. The lime is broadcast, applied around the tree, or mixed with the planting soil.

In many places where large planting stock is used, and particularly where newly planted trees are subject to strong winds, soil is heaped in a conical mound around the tree. The height and diameter of such mounds varies from place to place. Conical mounds 3 to 4 feet in diameter and 1 foot high at the tree are recommended in England. Poplars planted on sites exposed to high winds are mounded somewhat higher.

First-Year Plantation Care

The intensity of protection and culture during the first year after planting varies from none to seemingly unnecessary extremes. On windy sites poplars are sometimes individually staked. Where leaders are broken, a lateral may be tied upright to a splint to avoid crook.

Where necessary, the poplars are protected against rabbits by guards made of roofing paper, asphalt paper, or hardware cloth. Occasionally barbed wire on 3 posts, or even rail fences 5 to 6 feet square, are built around each tree for protection against deer and cattle. The costs are said to be justified by the income derived from hunting leases or grazing values.

Cultivation

All poplar experts now agree that grass and weeds inhibit the growth of newly planted poplars. The most intensive cultivation is applied to plantations on land that is used for agricultural crops during the first 3 to 5 years after planting. This is the most common practice in Italy and Spain (fig. 18) and is practiced to some extent in France—particularly in the south, in the lower Rhine Valley in Germany, and in Belgium and The Netherlands. The stumps are removed after a poplar rotation and the land may be replanted immediately to poplar or it may be used several years, sometimes as much as 5 to 10 years, for agricultural crops before poplars are planted again.

On some estates in the Po Valley, agricultural crops are often interplanted primarily to cover the establishment, fertilizer, and early cultural costs of the plantation. After 3 to 5 years, when the yield of crops under a poplar plantation is reduced approximately 50 percent, the land is put into grass for hay and pasture. Such clean culture and fertilization results in extremely vigorous young plantations and produces high yields on 12- to 20-year rotations in southern Europe.

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FIGURE 18.—Newly planted poplars in the Genil River Valley near Granada, Spain. Agricultural crops will be grown for several years under the poplars.

On noncultivated land, or where the land is also used for hay and grazing, only the most progressive growers hand-cultivate an area 3 to 6 feet in diameter around each tree during the first year or two after planting. Examination of the stumps of many felled poplars in the Parisian Basin, where they are generally grown on grasslands, showed 3 to 5 extremely narrow rings immediately after planting.

The most important single factor responsible for the retarded growth of the Parisian Basin poplars is undoubtedly the deleterious effect of sod on newly planted trees. In view of the value of poplar timber and the susceptibility of poorly growing poplars to disease, the saving in labor costs and the small amount of grass that would be lost by cultivation or mulching around each tree is not adequate compensation for such drastic curtailment of early growth.

Mulching

A mulch heavy enough to eliminate weeds and grass is fully as effective as cultivation. At Mykinge, Sweden, a 10-year-old experimental plantation of very poorly growing Aigeiros hybrids on a brushy and soddy site was heavily mulched with straw in 1950. The effect of the late mulch was already apparent in 1952. The growth rate had increased and the foliage color was much improved.

It is not necessary to mulch the entire plantation area. In Great Britain, Peace and Jobling have found a marked early growth response, on almost every kind of site, to mulching an area 3 to 4 feet in diameter around each tree. Mulching individual trees to maintain growth after planting is an old practice but it

has never become general even in restricted localities. It is now recommended in Great Britain and is beginning to be more widely recommended and used on the Continent.

Significance for the United States

Fitted land, plowed and harrowed as for agricultural crops, is necessary for plantation establishment with unrooted cuttings, and it will also provide maximum growth conditions where sets or rooted trees are used. Normally such site preparation is possible only on cleared land.

On cut-over forest land or on land too brushy for plowing, minimum site preparation will require cutting the brush at least 4 to 6 feet around each planted poplar. Strips are most desirable, and where these are made by machine they should be at least 10 feet wide. If possible, the planting strips should be rototilled or treated with other machinery, such as a weed-hog or a heavy disk, to break up the root mat.

There is no sound justification in the European plantings, except those on the most windy sites, for severe pruning to whips—with or without short lateral stubs. The stubs actually provide entry for such diseases as *Valsa* and *Dothichiza*. Well-rooted unpruned trees have survived excellently and have made very good growth with careful planting on good sites.

One-year-old rooted cuttings should be planted in holes 12 to 18 inches in diameter, depending on the size of the roots, and 15 to 18 inches in depth. For 2+1 stumped trees the holes should not be less than 18 inches in diameter so that the roots need not be cut back too severely.

The application of approximately ½ to 1 pound of commercial fertilizer per tree, mixed with the soil at the time of planting, will greatly stimulate early growth. How much benefit may be derived from liming a short distance around each tree on soils with a low pH is still questionable. Where the soil pH is between 5.0 and 6.0, broadcast liming to bring the pH up to at least 6.0—and preferably to 6.5—will have a more lasting effect.

Mounding is beneficial where the newly planted trees are subjected to strong winds, but its value under less exposed conditions needs further investigation. Roots usually form in these mounds and if the mounds are eventually washed away these roots become exposed and may be subject to injury and infection by fungi.

Dormant unrooted cuttings have been used successfully to establish plantations of hybrid poplars by the U. S. Forest Service's Northeastern Forest Experiment Station. But it cannot be too strongly emphasized that they will be successful only on tilled land, and that they must be kept free of grass and weeds at least during the first year after planting.

The use of unrooted sets for outplanting on sites that have a high water table or on soils that remain moist all summer deserves wider testing. For best results, the sets should be vigorous shoots not less than 6 feet long, and they should be planted at least 24 inches deep, preferably with the butts in the ground water. One-

year-old whips are preferred but 2-year-old stems are being used successfully in Europe.

Rooted trees provide the greatest assurance of successful establishment where the land cannot be plowed and harrowed or given adequate soil preparation. One-year-old rooted cuttings are suitable for outplanting if they are 5 feet or more in height. Two + one stumped trees that have been dug and root-pruned at the end of their first growing season in the nursery will give better results on difficult sites than 1-year-old rooted cuttings.

Pruning to half the height of the tree has proved best for successful establishment and vigorous early growth. Progressive pruning during the last year in the nursery has the important advantage of smaller branch wounds and complete healing before the trees are outplanted. This can be recommended as the best practice on the basis of European experience.

In row plantings, where no thinnings are contemplated, hybrid poplars should be spaced 15 to 25 feet apart. Where the tree roots can spread laterally, the spacing depends mainly on the crown width of the clone and the size to which the trees are to be grown. Twenty-five feet is a safe distance if these factors are not known at the time of planting.

The traditional European notion that poplars cannot be grown in closely spaced forest stands is based on experience with single-clone plantations. Monoclonal plantings at close spacing deteriorate rapidly if they are not thinned before the growth rate is seriously retarded by the density of the stand. Single-clone plantations can be successfully matured with an original spacing of 4 by 4 feet, *provided they are thinned early and frequently*. Such close spacing is desirable to provide early ground cover where plantations are established with cuttings. Close spacing is also useful on low sites that are subject to overflow and where it is advisable to speed up the deposition of silt.

Plantation spacing of 15 by 15 feet, or thinning to this final spacing, can be recommended as biologically sound for the culture of Aigeiros hybrids on good soils. Mixtures of hybrids can be established at closer spacing without undue risk of stand retrogression due to delayed thinning. There is no evidence in Europe about the growth and development of random mixtures of many clones in closely spaced plantations. The possibilities of clonal mixtures are discussed under "Management and Silviculture."

If dormant cuttings are used for the establishment of a plantation, the plantation *must* be kept free of weeds during the first year by machine or hand cultivation. For satisfactory early growth it is also necessary to keep a weed-free area, 4 to 6 feet in diameter, around rooted trees or sets during at least 1 and preferably 2 years. The deleterious effect of grass and weeds on newly planted poplars may continue for 4 to 5 years depending on the fertility of the site and the depth of the soil. The grass and weeds may be eliminated by cultivation or by applying a heavy mulch, such as hay, straw, sawdust, or wood chips. Mulched trees should be fertilized.

Site preparation on cut-over forest and brush land will be possible at reasonable cost with machinery (brush cutters, rototillers) developed in recent years. Where such machinery is not available or is too expensive, site preparation can be reduced to cutting the brush for a distance of 6 feet around each widely spaced planting hole.

Cuttings provide the cheapest type of planting stock but require the most intensive site preparation and cultivation after planting. They can be cultivated with minimum expense if they are check-planted to permit machine cultivation in two directions. The use of cuttings can be recommended for the farmer or landowner who has machinery available for fitting the land and cultivating the plantation during the first year.

Sets are cheaper than rooted trees but their use is limited to sites that have abundant moisture during the entire growing season. The cheapest rooted stock will be 1-year-old cuttings. The cost of 2+1 or even 3+1 stumped trees should not be excessive in nurseries that are equipped with tree diggers designed to handle large nursery trees.

The most profitable plantation spacing will depend on many factors; and among these the markets available to the grower must be considered. At the present time thinnings are a low-value product salable primarily to the cellulose industry, and therefore close planting usually will be advisable only where a market for such wood is available.

Close spacing will add relatively little to the cost of establishing plantations with cuttings; but the cost, or the time required, for thinning young plantations must be considered. A spacing of 8 by 8 feet should eliminate the need for thinning before a plantation of mixed clones reaches merchantable pulpwood size.

Since the production of high-quality logs for veneer or lumber requires proper pruning even in forest stands, plantations for such products can be established at a final crop-tree spacing of 15 by 15 feet. Where the land is to be used for poplars and grass, the distance should be increased to 25 by 25 feet.

The cost of planting rooted trees must be considered in deciding the plantation spacing distances. If a soil auger mounted on a tractor is available for digging the holes, the cost of planting 100 to 200 trees per acre would not be excessive. The cost of ½ to 1 pound of fertilizer per tree, and the cost of liming, is a reasonable establishment cost for hybrid poplar.

MANAGEMENT AND SILVICULTURE

Leuce Poplars

Management

The European aspen is normally associated with other broadleaf and coniferous species; but, like the American aspen, it also grows in pure stands after catastrophe, particularly fire. No instances of aspen management were observed in western continental Europe. In the Scandinavian countries aspen is generally

managed extensively, seldom intensively, in mixture with spruce, birch, or both. Investigations and publications on the silviculture and management of native aspen stands have been sponsored by the match industry in Norway and Sweden, and interest in more intensive management has increased greatly in recent years. Aspen is considered a liability by some foresters managing Scotch pine in Scandinavia because it is the alternate host of *Melampsora pinitorqua*. This rust disease can cause high mortality in Scotch pine seedlings and serious crooks in the leaders of older trees.

In spruce-aspen stands in Sweden and Norway the aspen is maintained in the stand during the later years of the longer conifer rotation as scattered codominants or intermediates, or through a succession of root suckers that replace trees lost through suppression. Any merchantable aspens in the spruce-aspen stand are harvested with the conifers. In the second rotation, the aspen becomes the dominant species by natural regeneration mostly from root sprouts. When there is advanced spruce reproduction or seed trees in these stands, relatively little sivicultural work is required to develop a fully stocked spruce understory for the spruce-aspen third rotation.

Managed stands of European white poplar were not observed or mentioned in western Europe. This poplar forms such dense natural stands by prolific root suckering in the river valleys of southern France that it is difficult to estimate the extent of regeneration by seed. In one such stand the largest trees were 12 to 15 years old, 10 to 13 inches in d. b. h., and 60 to 70 feet in total height. Stem form resulting from early natural pruning was excellent.

Thinning

The natural aspen stands in Scandinavia, both pure and in mixture, are maintained at a relatively high density by light thinnings started soon after the aspen has reached merchantable size. Although there is little uniformity in the length of the cutting (thinning) cycle, the following tabulation,[7] based on relatively even-aged, naturally regenerated stands in Norway and Sweden, indicates the general effect of intermediate cuttings on the density of the aspen:

		Trees per acre		
Age (years):	Stands (number)	Aspen (number)	Spruce, birch, or both (number)	Total (number)
20	1	680	93	773
30–39	5	333	134	467
40–49	6	230	142	372
51–56	3	161	301	462

[7] Data derived from the following reports:

Anonymous. *Sätra bruk.* Särtryck ur programmet för Svenska Skogsvardsföreningens 26:te exkursion till Skaraborgs län 9–11 juni 1938. 16 pp., illus. Stockholm. 1938.

Barth, Agnar. *Aspen. Dens kultur og behandling for kvalitetsproduksjon.* Fra ingeniør F. H. Frølichs fond for aspeskogbrukets fremme Nr. 1. 87 pp., illus. Oslo. 1942.

The high average of "other" trees in the three 51- to 56-year-old stands represents higher original stocking. The 20-year-old stand was a mixture of aspen and birch. Mixed stands of aspen-spruce or aspen-spruce-birch normally carry a higher proportion of the associated species.

Aigeiros Poplars

Management in forest stands

It is the traditional concept in Europe that Aigeiros poplars cannot be managed in typical forest stands. There is abundant evidence that single-clone plantations of the commercially planted poplars cannot be matured profitably without careful and regular thinning if planted closer than 16 by 16 feet on the best sites, or closer than 26 by 26 feet on average sites.

There is no evidence in Europe on management of a random mixture of many poplar clones of different parentages in closely spaced (forest) plantations. But there are many examples of successful management of poplars in bottom-land hardwood forests.

In Schleswig-Holstein, Germany, hybrid poplars were planted into openings in a young beech-oak stand on an excellent well-drained alluvial soil. The poplars at 56 years of age averaged 20 to 21 inches in d. b. h. (maximum 30 inches) and 100 to 110 feet in total height. The peeled volume of the largest trees was estimated to exceed 200 cubic feet. The trees were clean boled for 40 to 60 feet—evidence of an early and continuously dense stand. On the Rhine bottom lands in Baden the highest quality and most profitable poplar stumpage is grown in mixed forest stands with native hardwoods.

The poplars near Yvonaud, Switzerland, are in mixed stands with alder and other native bottom-land species. At 50 to 60 years the average height of the poplars is more than 100 feet with a reported volume (poplar) of more than 9,000 cubic feet per acre. A poplar-birch mixture approximately 50 years old in the same locality showed similarly excellent growth of the poplars. The local foresters were not certain about the history of the birch, which was younger than the poplar. It may have been interplanted later, or it may be sprout regeneration from birch planted with the poplar. In the community forest of Noville, 2-year-old rooted poplars were successfully established in openings left by removal of mature oaks.

Poplars have also been used to convert coppice to high forest. In France for example, *Populus* 'Robusta' and 'Serotina' had been planted in strips cut through an old coppice stand of oak, beech, hornbeam, and other species on a silty sand in which the water table was reported to vary in depth from 2 to 3 feet. After 25 years the original coppice species had disappeared almost completely under the poplar canopy.

Near Emendingen, Germany, hybrid poplars were planted into small openings in a bottom-land stand containing ash up to 43 years old, oak up to 90 years old, and described as coppice with

standards. The poplars, at 32 years, had grown up through the ash and oak and stood 15 feet or more above the forest canopy. Growth of the poplars had been fairly vigorous: the best trees had reached 24 inches in d. b. h.

Filler trees

Filler trees are interplanted to fill the gaps between widely spaced poplars on land that is not utilized for intercropping, hay, or pasture. They are occasionally used in row plantings. The use of filler trees is most common in the Rhine Valley of Germany, less common in France and the Low Countries where poplar plantations are frequently used for hay and forage and more occasionally for crops.

Where there is a market for fuel or specialty uses such as turnings, the filler trees often provide an early monetary return from the plantation, and in some localities they are planted primarily for this reason. But filler trees perform a far more important biological function: they provide the early ground cover needed to eliminate grass and weeds and to protect and improve the forest floor. They also function as trainers for the widely spaced poplars. Good poplar silviculture requires early and regular pruning; and shading of the pruned poplar stems by the interplanted species prevents or at least greatly reduces epicormic branching, which is often prolific on trunks exposed to full sunlight.

Black alder (*Alnus glutinosa* (L.) Gaertn.) and white or speckled alder (*A. incana*) are most frequently used for interplanting (fig. 19). The black alder is usually preferred; but in plantations on strip-mine banks at Hermülheim, Germany, the white alder, interplanted at 5 by 5 feet, has been found superior to the black. Black alder is reported to grow more slowly on these mine banks and fails to provide a sufficiently early ground cover at this spacing. Alder, because of its nitrogen-fixing nodules, is generally considered beneficial to the growth of poplar; however, there is still some doubt on this point.

The Research Institute of the Germany Poplar Society, in Brühl, was investigating the possibilities of a number of species for interplanting with poplar. They planned to interplant a 3-year-old poplar plantation with blocks of red oak, beech, black alder, black locust, hornbeam (*Carpinus L.*), and linden at a 5 by 5 feet spacing in the spring of 1953.

At Albalate, Spain, a poplar plantation at 13- by 13-feet spacing was interplanted with *Pinus canariensis* (fig. 20). After 5 years the poplars averaged between 45 and 50 feet in height. They will be removed at commercial maturity, probably at the end of 12 years, to leave a coniferous stand.

Where there is a market for thinnings, filler trees (particularly alder) are generally planted at close spacings of 3.3 by 3.3 feet to 5 by 5 feet because the necessary early and repeated thinnings are profitable. Present practice on state lands in Baden is to plant alder, ash, and willow at the same spacing as the poplars,

16.5 by 16.5 feet, to eliminate the need for early thinnings. If these filler trees grow into the crowns of the poplars, they are headed back at heights of 20 to 35 feet.

Plantation cultivation, fertilization, and irrigation

Cultivation of the entire plantation area during the first 3 to 5 years after planting was observed only where the land is also used for agricultural crops. Hand cultivation for a distance of 3 to 5 feet around the young trees has been practiced by a few growers in all regions.

Established plantations are seldom fertilized except where crop fertilizers are applied annually during the early years of intercropping. Experiments on annual and periodic application of fertilizers and lime have been started on the strip-mine banks in northwestern Germany.

In Italy, southern France, and Spain, poplar plantations are regularly irrigated on sites where irrigation is required.

Photo by G. HOUTZAGERS

FIGURE 19.—Twenty-year-old plantation of *Populus* 'Marilandica,' at St. Oedenrode, The Netherlands, with coppice understory of alder.

Photo by FERNANDO JAIME FANLO

FIGURE 20.—A poplar plantation underplanted with *Pinus canariensis*, on river-bottom land at Albalate del Arzobispo (Teruel), Spain. The plantation was established in 1946; the photo was taken in October 1954.

Thinning

Single-clone plantations can seldom be retrieved successfully where vigor has been seriously reduced because of too close spacing; the occasional exceptions are on particularly excellent sites with deep soils. Degenerate plantations resulting from failure to thin at the proper time can be seen in every poplar region of Europe. It is primarily for this reason that poplar foresters recommend planting distances wide enough to eliminate the need for thinning.

Initial spacing and earliness and frequency of thinning depend on local land use and local market conditions. Close spacings, when the plantation is thinned frequently and at the proper time, provide a higher total yield per acre than wide spacings because they produce additional wood in small sizes from the thinnings without reducing the growth rate of crop trees. But close spacing is practical only where thinnings can produce a profit, and this is impossible in many parts of Europe. For example, in The Netherlands the estimated establishment cost per tree has been

more than the pulpwood value of an 8-year-old tree, the maximum age at which a first thinning must normally be made in a 6.5- by 6.5-foot planting.

European recommendations for thinning poplar stands are derived from general observations, growth studies, and thinning experiments in plantations at various spacings. There is considerable difference of opinion because the comparisons have been based on commercial plantings established under different conditions. Differences due to clones carried under a single cultivar name, site and site preparation, condition of planting stock, year of planting, planting methods, culture, and other biological variables are hopelessly confounded in such comparisons. The most common basis for thinning recommendations is to thin without making overly large holes in the canopy as soon as the crowns touch.

The most generally accepted final spacing for mature stands is 20 by 20 feet to 26.4 by 26.4 feet. In the Po Valley, triangular spacing of 24.5 feet is said to provide the most profitable yields. On the deep alluvial soils along the Rhine in Baden, common practice has demonstrated that a final spacing of 16.5 by 16.5 feet is biologically and financially sound. The plantations spaced at 5 by 5 feet in southern Spain are usually thinned to half the number of stems at the middle of the 12- to 14-year rotation (fig. 21 and fig. 22).

There is also some difference of opinion about whether release should be uniform around the entire crown of the residual trees or whether release can be "sidewise." This is important where the original planting distance is relatively wide, because in regularly spaced plantations removal of every other tree—a 50-percent thinning—is necessary to free the residual crowns on all sides. With initial spacings of 10 by 10 feet or wider, a 50-percent thinning in a stand without filler trees opens the stand to an undesirable degree. A lighter thinning allows more gradual release but produces irregular openings that tend to produce crooked trunks and eccentric crowns. Both conditions may affect the wood quality through the formation of tension wood.

Mixed stands of poplar with filler trees or volunteer species usually receive silvicultural thinnings to favor the poplars as crop trees. In Baden the filler trees are often topped at 20 to 30 feet to eliminate interference with the poplar crowns and still maintain full ground cover and shade on the poplar trunks to prevent epicormic branching.

Pruning

Proper pruning is essential even in closed stands for production of the highest quality logs, particularly for veneer. Although there is general agreement on what constitutes good pruning, this is probably the most frequently mishandled cultural treatment. Local traditions and uses are often responsible for extremely bad pruning practices.

The severest pruning was encountered in the Mediterranean region of France and Italy, where the native black poplars, and

Photo by FERNANDO JAIME FANLO

FIGURE 21.—Nine-year-old poplar plantation at Bordils (Gerona), Spain.

particularly the Lombardy types, have been put to multiple uses for centuries. The poplars are usually pollarded high and pruned annually, or severely pruned as standards, for fagots; and during dry summers when forage is scarce, the leaves and young shoots may be stripped for fodder.

Pruning to small feather-duster tops every year or two, with abundant production of watersprouts, is common where fuel is scarce. Examples of 60- to 80-foot poplars stripped of all branches to the current year's leader are not uncommon. In the region of Naples, where pollarded poplars used as vine supports (fig. 23) also provide fuel and lumber, the most fertile soils support a 3- and occasionally a 4-story culture: poplars, grapes, sometimes dwarf fruit trees, and an annual crop or forage.

Examples of excessive pruning can be found also in other poplar-growing regions of continental Europe. Where there is a local shortage of fuel, the immediate need for fagots overshadows any enhanced timber value. Even where fagots are not a primary

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FIGURE 22.—Merchantable thinnings from 5- to 6-year-old plantations in the river-bottom plantings at Oliete, Spain.

consideration, farmers frequently prune too high if the poplars shade cultivated fields.

Local labor costs largely determine the frequency and carefulness of pruning on community and larger private ownerships. On such properties the best pruning practices were observed where there is a limited market for fagots and labor is cheap in relation to the value of high-quality poplar logs. Where there is a good market for fagots, pruning is often too severe.

Where labor costs are relatively high there is also a tendency toward less gradual pruning to provide some heavier branch wood for sale and to reduce the labor costs (fig. 24). Such delayed pruning leaves large knots that heal poorly; the removal of 6 to 10 whorls may reduce growth; and on widely spaced trees such pruning almost invariably induces a heavy crop of watersprouts. The result is often a decrease rather than an increase in log quality.

Pruning is done in many ways and with various tools. Climbing the trees and pruning with a hand ax is still a common practice, but the use of ladders and pole tools is increasing. Climbing irons are said to be commonly used in southern France—with detrimental effects on log quality.

The best pruning was observed in Germany, The Netherlands (fig. 25), Belgium, and northern France. The pruning practice of the Belgian Match Company is typical of good plantation management. Eight to 10 years after planting, the trees are pruned to one-third of their height, between 10 and 15 years to half their height, and after 15 years the pruned stem is increased to its final length of approximately two-thirds the total height.

The trees are not pruned regularly each year; for example, a 21-year-old plantation near Boussu was pruned for the fifth and

the last time at 19 years. The crowns are also thinned to three or four branches per whorl between the 8th and 15th years to reduce the number of knots in the crown section and to "give the trees more air and light." Such crown thinning was not observed in other parts of Europe.

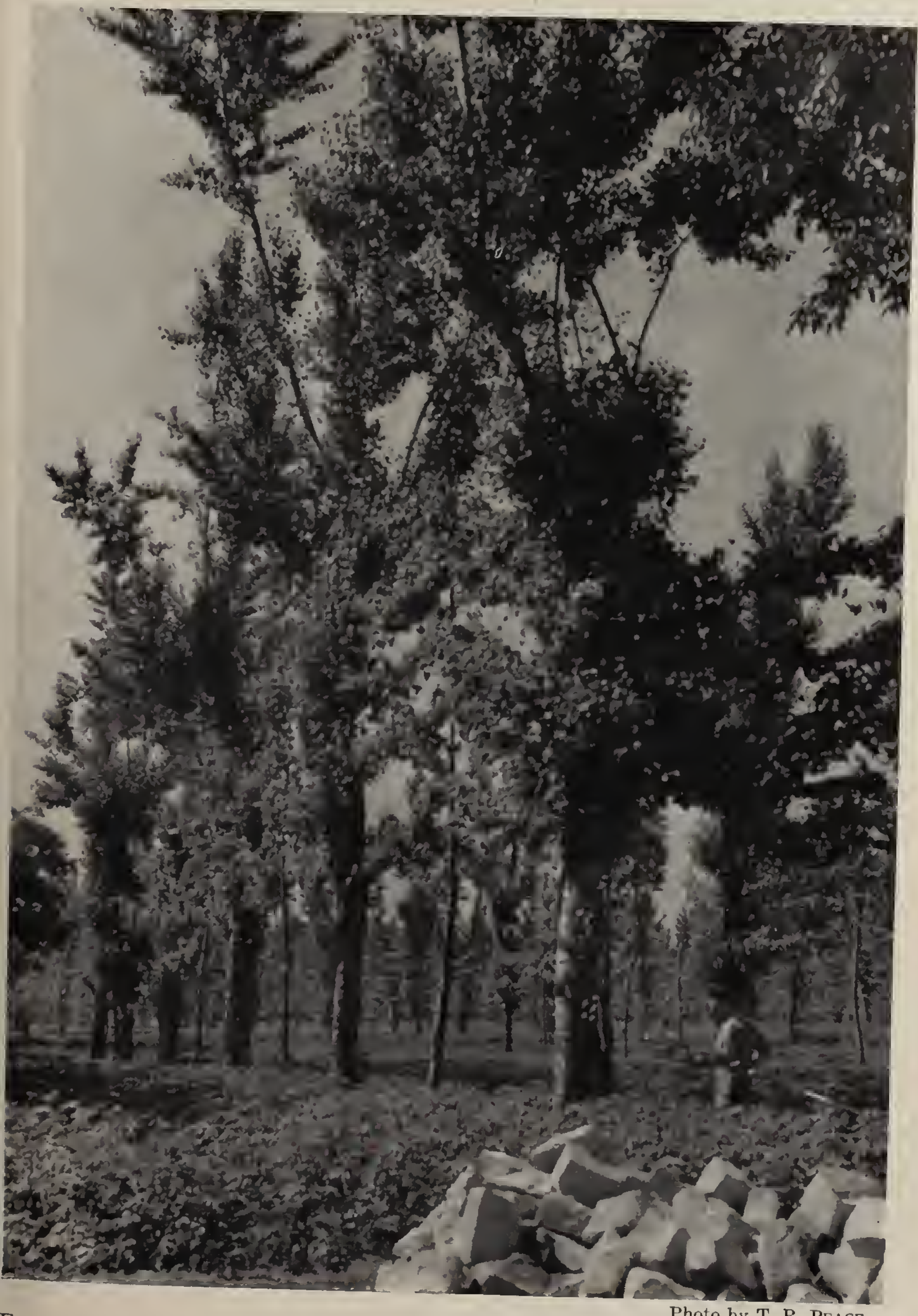

Photo by T. R. PEACE

FIGURE 23.—Poplars used for vine supports with continuous intercropping. Vicinity of Naples, Italy.

The following rules for pruning poplars, taken from *Das Pappelbuch* (see footnote 5, p. 40), would be accepted by most poplar foresters throughout Europe as biologically sound; but many would question the economic applicability where the work must be done by hired labor.

- Start pruning in the 5th year after planting.
- From 5 to 10 years prune one whorl of branches annually.
- From 11 to 30 years prune one whorl every 2 years. At 30 years the final crown length should be 60 percent of the tree height on open-grown trees, 40 to 50 percent on plantation trees.
- Prune live branches from early spring, but not at freezing temperatures, until mid-August. Remove new watersprouts in July. Dead branches can be pruned at any time.
- Use chisel tools only for live branches up to 1.2 inches in diameter; for larger branches use pole saws and handsaws.


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FIGURE 24.—Twenty-year-old *Populus* 'Robusta' along a farm road. The trees are spaced 26.5 feet apart in the rows. Here pruning has been delayed too long. The local market for fagots tempts the grower to delay this work until the branches are large enough to pay the pruning costs. Holtwick, Germany.

NED. HEIDEMIJ. (ARNHEM) photo

FIGURE 25.—A row planting of *Populus* 'Robusta' along a secondary road in The Netherlands. These trees have been properly pruned.

Rotation

The rotation for Aigeiros poplars and their hybrids is extremely variable—from 12 to 60 or 70 years. The shortest rotations are practiced where wood is scarce and the climate and soils favor rapid growth. In the Mediterranean region of Spain and in Italy, plantations are often harvested 12 to 15 years after planting, but rotations of 18 to 25 years are recommended as most profitable.

Longer rotations—20 to 40 years, depending primarily on the site and growth vigor of the clone—are the rule in France, Belgium, The Netherlands, and where wood is scarce in Germany. The Raverdeau Nursery in the Parisian Basin favors a 20-year rotation for *P.* 'Robusta,' which is said to grow rapidly in the first 10 to 15 years; and a longer rotation for 'Serotina,' which surpasses 'Robusta' after 20 years.

Where Aigeiros hybrids are grown in mixed forest stands with native species, particularly in Germany, the rotation may be as long as 70 years. Such management produces large, clear logs of highest value for sliced and rotary veneer.

Natural regeneration

The Aigeiros hybrids are always planted. Regeneration by seed is not practical because many cultivars are male and the seed of female hybrids would not breed true. But when the tree is cut,

most if not all of these hybrids produce root suckers wherever the surface roots are exposed. Although scarification with a drag or disk harrow before logging would provide exposed roots for prolific root suckering, regeneration of plantations by this means has not been given serious consideration in Europe. The most probable reasons are that a dense stand of root suckers would make intercropping or grass culture on the land impossible, and delayed weeding of such a dense single-clone stand could result in serious deterioration.

Significance for the United States

The management of American aspen can be recommended only in regions where there is a market for the wood and where climate and soils are unsuited for the more rapid-growing Aigeiros or Tacamahaca hybrids, or for more valuable native species. The possibility of managing aspen in mixture with spruce or other native species, as the European aspen is managed in Scandinavia, deserves study on favorable sites in our northern regions.[8]

There is abundant evidence in Europe that a single clone should not be planted in closely spaced plantations unless there is positive assurance that thinnings will be made at the proper time. But there is no evidence to indicate that random mixtures of clones of different parentages cannot be grown at close spacing.

Dense natural seedling stands of our native cottonwood and of the European black poplar, where they still occur, mature into excellent forest stands by natural thinning. There is, however, a basic biological difference between such a seedling population in which every tree is a different genotype, and a monoclonal stand in which all trees are identical genotypes. With very rare exceptions every tree in a seedling stand differs more or less from its neighbors in some or all of its physiological characteristics. Such genetic variation is completely lacking in a monoclonal stand.

Forest plantations should be established with mixtures of carefully selected and tested clones of as many parentages as possible. In such a stand there will be little chance that an individual tree will be surrounded by ramets of the same clone.

There is one such example in Maine where approximately 13,000 hybrid seedlings, representing 95 parent combinations, were planted at 6- by 6-foot spacing in 1927 and 1928. The seedlings were grouped by parentage and the plantations were never thinned. Many parent combinations have been partially or completely eliminated by climate, disease, and insects; yet there are some parentages in which survival is still better than 70 percent. Here the hybrid plantation has followed the same developmental pattern as a seedling stand of a native species. There has been sufficient genotypic variation between seedlings of even the same

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[8] Study of mixed aspen-conifer stands, chiefly balsam fir, is under way in the Lake States. Personal communication from Paul O. Rudolf, U. S. Forest Service, Lake States Forest Expt. Sta. 1956.

parentages to produce a stand of dominant, intermediate, and suppressed trees. Close spacing has not resulted in the uniform loss of vigor in all individuals with resulting decadence of the entire stand.

The interplanting of filler trees in poplar plantations is biologically advantageous. The best filler species for use in the United States would depend on local climate and site conditions. Commercially important species should be used where the objective is conversion to the filler species or the development of a mixed stand. Volunteer native species should be retained as fillers, particularly on cut-over forest land and brushland. At present the planting of alder and other commercially inferior species as filler trees cannot be recommended.

Hybrid poplars can be grown in forest stands with native species. Mixed stands permit wide spacing of the poplars and silvicultural thinnings to favor them as crop trees. Such stands will require relatively less cultural investment—particularly in pruning, will reduce the risk by the inclusion of species known to be adapted to the environment, but will tend to increase the length of the poplar rotation.

Close spacing, with early and frequent thinnings, will produce higher total yields of cellulose per acre than wide spacing without thinning. Wide spacing will usually be advisable where there is no market for thinnings. Row plantings are preferred to plantations with close spacing for the production of cellulose and quality logs, because they are less susceptible to deterioration from delayed thinning.

Pruning methods recommended in Europe are biologically sound. Growth rate can be maintained by gradual reduction of crown length over a period of 10 to 20 years after the trees are well established—6 to 8 years after planting. The advantages of pruning while branches are small to get clean pruning cuts and of pruning early in the growing season to get rapid healing are obvious. The effectiveness of paints to eliminate the risk of infection of wounds after winter pruning should be investigated.

Annual pruning can be recommended for the farmer or landowner who can do this work in slack seasons. Since winter pruning fits best into the workload of the American farmer, it may be done during this season in spite of the risk of infection by diseases and wood stains. Pruning for high-quality veneer logs should be started when the trunk reaches 6 or 7 inches in diameter, the size of the core to which peeler logs are turned, rather than at a specific age. On this basis pruning would start at an earlier age on a good site than on a poor site, and earlier on fast-growing hybrids than on slow-growing types.

DISEASES

Trunk, Branch, and Twig Diseases

Bacterial canker

This is the most serious disease of poplars in northwestern Europe and Great Britain (fig. 26). It was first reported as epidemic in The Netherlands on the local 'Brabantica' poplar, which came into high favor about 1860 and was grown extensively because of its excellent growth rate, good form, and desirable wood quality. As early as 1870 this cultivar was observed to be suffering from disease and by 1875 it was reported that very few healthy specimens were to be found.

GREAT BRITAIN FORESTRY COMMISSION photo

FIGURE 26.—Bacterial canker on *Populus* 'Eugenei' in a test planting for disease resistance in England.

Studies of the disease were reported in 1900 in Belgium, and in 1906 it was described as the most common type of canker in northern France. Bacterial canker became so serious in The Netherlands and in the adjacent Low Countries that it threatened the commercial growing of poplars. This led to the clonal selection

work of Dr. Houtzagers during the 1930's and the compulsory certification in The Netherlands of clones that are resistant to this disease.

Bacterial canker is characterized by the initial appearance of small cracks in the bark, which exude a light-colored bacterial slime during the first year. Callus forms around the infected area as the disease progresses, and this produces the characteristic swollen nonhealing cankers. Trunk cankers may occasionally kill a tree rather quickly by girdling, but usually the numerous cankers that develop on the branches kill the tree gradually by reducing its living crown over a period of years (fig. 27).

The presence of slime is a definite diagnostic character in young cankers, but in old cankers slime is not always present. For this reason it is not possible to diagnose all older branch and trunk cankers with absolute certainty. In France, the author was shown 'Regenerata' poplars 20 to 25 years old, with unusually large cankers on the lower 15 feet of the trunks that were characterized by vertical slits in the bark. These have been assumed to be bacterial cankers.

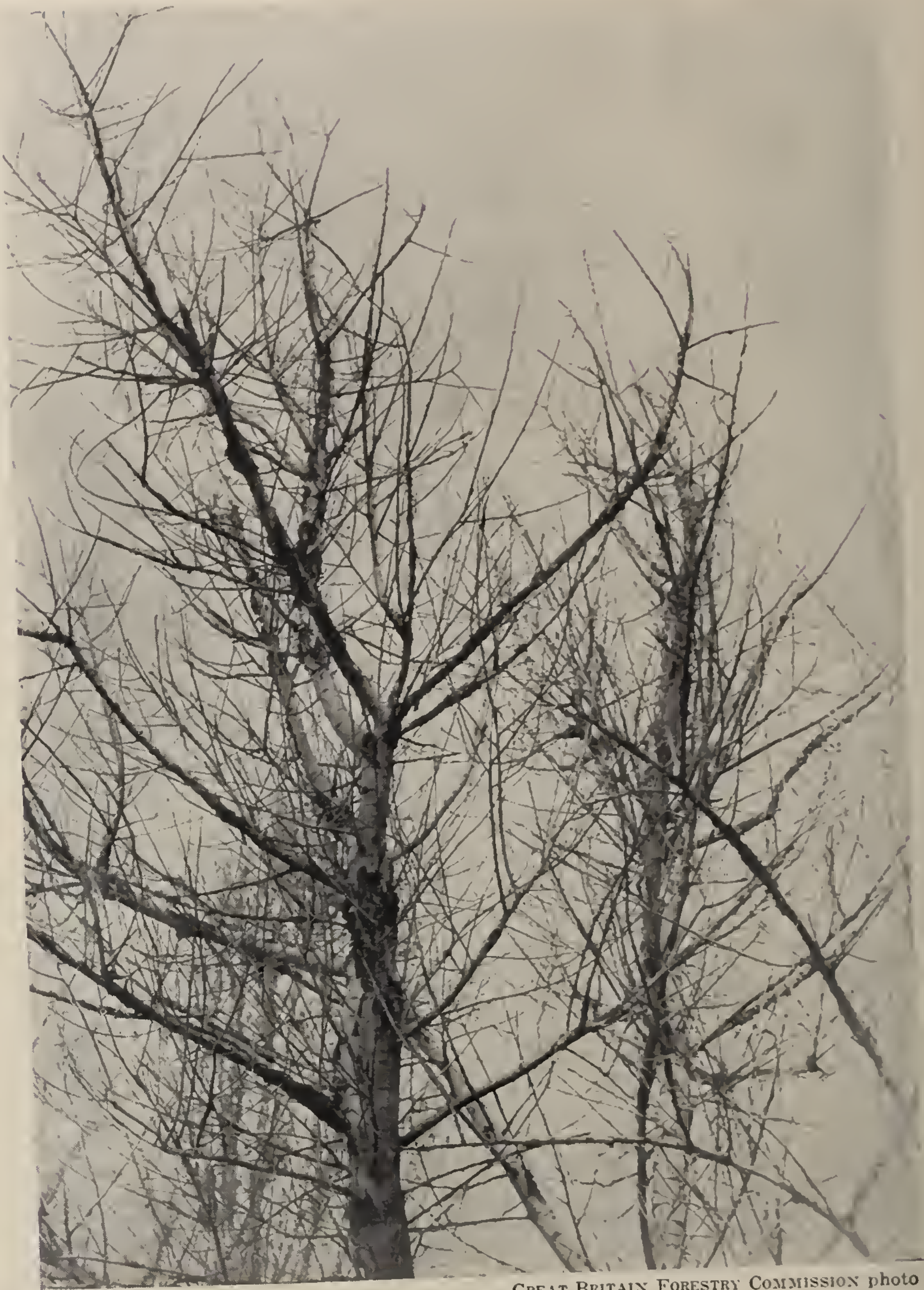
Typical bacterial branch cankers, as diagnosed from the ground, were present on some of the trees with trunk cankers, on others the branch cankers were lacking. A cautious investigator would not classify such cankers as bacterial without cultural evidence; they may have originated from other primary causes. M. Chardenon, of the French Match Company, suggested that climatic or other environmental conditions during a particular year or series of years might account for these unusual trunk cankers.

Bacterial canker has been investigated in several countries; the most intensive and continuous research was started in The Netherlands about 1936. It is now generally agreed that a bacterium, *Pseudomonas syringae* (v. Hall) E.F.S. f. sp. *populea* Sabet (synonym: *Ps. rimaefaciens* (Sm. et Towns) Koning), is responsible for at least the initiation of the disease. The evidence in The Netherlands indicates that the most susceptible period is in the spring, but this may differ from year to year as to exact dates. Although individual clones vary in degree of susceptibility in different years, their relative susceptibility as compared to other clones is usually the same from year to year.

Netherlands pathologists have found that the typical syndrome of bacterial canker is not induced by inoculation with pure cultures of the bacterium. Such inoculations produce infections and swellings that heal over in the first or second year. (These healed infections resemble, superficially, the trunk scab described on p. 75.) It is necessary to inoculate with the raw slime or, as Sabet reported from England, to supplement the inoculation of the pure bacterial culture with sterilized slime, to obtain a typical canker.

Bacterial canker is so serious in Great Britain that selection and inoculation tests have been under way for some years. Old multiclonal plantings where bacterial canker has been present for many years indicate that under conditions of natural infection some individuals are resistant. Disease-free ortets have been selected from such plantings for pathological tests.

The role of other bacteria and fungi that are usually associated



GREAT BRITAIN FORESTRY COMMISSION photo

FIGURE 27.—Branches and upper trunk of *Populus* 'Eugenei' heavily infected with bacterial cranker. Near Farnborough, Hants, England.

with this canker is in doubt. It is possible that the bacterial infection alone, without secondary pathogens, might not result in the serious losses associated with this disease.

It is now known that there are clones that are highly resistant to artificial inoculation, but it is not yet proved that there are any

completely immune clones. There is some indication that the severity of bacterial canker, and possibly even susceptibility, may be intensified by poor growing conditions. The Zwolle clonal test of the Netherlands Land Reclamation Society is on a poorly drained peat soil. The growth of all clones is very poor and bacterial canker is much more prevalent and more severe than on two comparable plantings of the same clones on good sites in the central and southern Netherlands. Even clones that are highly resistant to artificial inoculation when tested on a good site show cankers in the Zwolle plantation in some years when climatic conditions favor the disease. It is reported that this is the only site in The Netherlands where trunk cankers have developed on *P.* 'Serotina.'

There is no information available as to the possible existence of distinct physiological strains of the primary pathogen (differing in pathogenicity) in various parts of Europe. Inoculum from the same regional source has always been used in the intensive inoculation studies carried out in The Netherlands on many clones over a long period of years.

The fact that bacterial canker has not been reported from southern France or Italy may indicate natural environmental control of the disease organism, the occurrence of a different syndrome, or absence of the carrier or carriers of the disease. It is improbable that there has been no opportunity for transport of the bacterium to southern Europe.

The problem of clonal susceptibility to natural infection has not been studied with sufficient precision to warrant sound conclusions. Such tests are necessary for new selections. A clone that is superior in all respects except its susceptibility to *artificial* inoculation might have other inherent attributes that would protect it from natural infection. For example, it is not known how bacterial canker is transmitted from tree to tree. If it is carried by insects, then susceptibility to natural infection would be correlated with the degree of clonal attractiveness to such insects.

Tacamahaca poplars and their hybrids are generally considered highly susceptible to bacterial canker, and for this reason there is a strong prejudice against this entire group. The prejudice is based on observations and tests of relatively few clones in comparison to the number of Aigeiros clones involved in the years of natural and artificial selection for disease resistance. Inoculation tests in Great Britain have now clearly indicated that there are clones of *P. trichocarpa*, *P. balsamifera*, and their hybrids, which are highly resistant to bacterial canker.

There are examples of Tacamahaca poplars within the natural range of this disease that are free of bacterial canker. Such cases may be purely accidental but they merit further tests. A row of healthy, 30-year-old 'Berolinensis' poplars on the old castle grounds in Schleswig, Germany, averaged 90 feet in height and approximately 26 inches in d. b. h. There was no excessive borer injury on the branches of these trees and no evidence of any disease. 'Berolinensis' is reported to be healthy in this locality.

Spring dieback

This disease—called Defogliazione primaverile, literally translated "spring defoliation"—almost eliminated profitable poplar culture in northern Italy and was a primary incentive for the establishment of the Poplar Institute at Casale Monferrato. There is much confusion over the scientific name of the fungus responsible for this disease. In Italy, *Pollaccia elegans* Serv. (perfect stage, *Venturia populina* (Vuill.) Fabr.) has been reported to be the pathogen on Aigeiros poplars, and a second species *Pollaccia radiosa* (Lib.) Bald. and Cif. (perfect stage, *Venturia tremulae* Adreh.) on *P. alba*.

In Spain, the perfect stage of the fungus responsible for dieback ("la defoliacion de primavera") is reported to be *Didymosphaeria populina* Unamuno. It is considered to be distinct from *D. populina* Vuill., *Venturia populina* Fabr., and *V. tremulae* Kleb.

Napicladium tremulae (Frank) Sacc. and *Pollaccia radiosa* (Lib.) Bald. and Cif. have been identified as the cause of this disease in northern Europe.

The disease kills the young leaves and new shoots in early spring, usually before the leaves have reached their full size. Young twigs girdled by insects may have the same appearance but are easily distinguished from spring dieback. The dead, blackened, immature twigs and leaves may remain on the trees as "flags" into the summer. Repeated defoliation can be serious enough to cause the death of the tree, but it is not always certain whether death is due to this fungus alone or to the invasion of secondary parasites.

During 1952 the author found only one locality in which heavy mortality might be ascribed to the primary effect of spring dieback. A 12-year-old plantation of *P.* 'Berolinensis' in Lolland, Denmark, was in critical condition after several years of heavy infection. It was impossible to determine whether the decline and heavy mortality was due entirely to repeated spring dieback or to a combination of dieback and other pathogens. There was no indication of typical bacterial canker on these trees, but they did have small brownish to black necrotic areas on the trunks much like the trunk scab of 'Robusta' in Germany. Since this plantation was on rather heavy and poorly drained soil it is possible also that site conditions may have been responsible in part for its early deterioration.

Clonal variation in susceptibility was apparent in this plantation. Although the stock had been presumed to represent a single clone, there appeared to be at least two clones. Among the rather wide-spreading trees that were heavily infected and dying there were a few more columnar individuals that were very lightly infected and appeared to be in good health.

In Sweden it is reported that in some years spring dieback drastically reduces the growth of young trees of *P. tremula*, particularly trees under 5 years of age. The disease is not considered to be of practical importance after the trees reach a height of about 20 feet. Severe spring dieback apparently has not been observed on the *tremula* × *tremuloides* hybrids.

Isolated cases of spring dieback, too light to have any effect on the growth of poplars, were observed in practically all European poplar regions. A few trees of 'Regenerata' and 'Robusta' in the poplar nursery at Schmalenbeck, Germany, had typical symptoms. Near Bellinzona, Switzerland, in a new planting of white poplars from Italy, some of the trees were heavily infected. Dieback was also present in Spain. In England it is thought to be associated with dieback of aspen.

Spring dieback is an arrant menace to poplar culture that fortunately can be eliminated by the breeding and selection of resistant clones. Selection of resistant hybrids has eliminated the danger of epidemic losses in Italy, at least until physiological strains of different pathogenicity are imported or develop in Italy. Constant vigilance is necessary because it is uncertain whether different species or races of this pathogen vary in virulence and pathogenicity.

Canker and stem dieback

Several fungi cause stem dieback or cankers, depending on the vigor of the tree or the part of the tree that is infected. Where small and weakly growing stems and branches are quickly girdled and killed, particularly during the dormant season, the syndrome is usually called bark necrosis, stem or branch dieback, or simply dieback. On larger branches or trunks where the infection is limited by callus formation around the dead sunken area, it is called canker. Such cankers usually increase in size by periodic advances of the pathogen and new callus formation.

Dothichiza populea Sacc. et Briard.—Stem dieback and cankers due to *Dothichiza* can be found in all parts of Europe. It has become so generally associated with dieback of poorly growing trees, particularly newly planted trees, that growers and foresters who are unfamiliar with the pathology of the poplars usually attribute all cases of stem necrosis to this fungus. In all countries, some examples of *Dothichiza* disease that were called to the attention of the author proved, on close inspection, to be due to *Valsa*.

The fungus is characterized by olive-colored tendril-like sporehorns that are exuded from the fruiting bodies through small ruptures in the dead bark during damp weather. It is particularly virulent on newly planted trees on unfavorable soils, where grass is inhibiting their growth, or where the trees have not been properly planted.

The European belief that *Dothichiza* is a facultative parasite, highly virulent only on young trees that are growing poorly because of other conditions, is supported by general observations but has not been proved by research. Observations in a few plantations pose the possibility that more virulent strains of this fungus may be present in some localities.

There is also evidence that *Dothichiza* can be serious on older established poplars. Many trees in an 18-year-old *P.* 'Robusta' plantation in the lower Rhone Valley had elongated and slightly sunken cankers on the upper trunks. Although both *Dothichiza* and *Valsa* were found in the tops of felled trees, *Dothichiza* was

most abundant. This plantation, spaced 13 by 13 feet, was on a deep silt soil over coarse sand, and in dry summers the water table could drop to 12 feet. The last 10 years had been relatively dry; 1947 and 1949 were exceptionally dry years, with 70 rainless days in the summer of 1949. The detrimental effect on growth vigor of the prolonged dry weather may have been responsible for the prevalence of disease.

Bordeaux mixture and other fungicides are used for control of *Dothichiza* in the nursery and in newly established plantations. The most common way to protect new plantations against this disease is to maintain the trees in strong vigor by careful planting, fertilization, clean culture, and irrigation where necessary.

The Italian method of taking cuttings from 1-year-old stumped trees is spreading to other countries. This eliminates the danger of incipient disease in cuttings from old stools that have accumulated such facultative parasites as *Dothichiza* and *Valsa*.

Dothiorella spp.—*Dothiorella* has frequently been reported to produce much the same syndrome on poplars as *Dothichiza*. Severe damage by *Dothiorella populnea* Thüm. and *D. populina* Karst. was reported in the Provinces of Burgos and Leon, Spain, in 1942 and 1943. A plantation of fastigiate, columnar, and medium wide-spreading types at Carrion de los Condes, inspected by the author in 1952, was especially interesting for the variation in disease and insect resistance.

Although most of the fastigiate types had succumbed to *Dothiorella*, there were at least three clones in this plantation in 1952. Some of the remaining fastigiate trees were heavily infested with both gall aphid and a small leaf spot resembling *Septoria*. A few fastigiate individuals, with larger and darker green leaves than the infested trees, had practically no aphid galls or leaf spots. The columnar and wider-spreading types in this plantation appeared to be free of disease and insects and were making excellent growth.

Valsa spp.—*Valsa* species have practically a worldwide distribution and *V. sordida* Nitsch. (imperfect stage *Cytospora chrysosperma* (Pers.) Fries) is present everywhere in Europe. This fungus causes dieback and cankers that can be distinguished from *Dothichiza* in the field only if the fungus has fruited. The sporehorns of the imperfect stage (*Cytospora*) are bright orange in color. If the sporehorns are gone, *Cytospora* can still be recognized by the somewhat smaller bark ruptures through which the spores were exuded.

Although it is normally saprophytic on dead branches, *Valsa sordida* can assume a parasitic role on trees that are in poor vigor from other causes. In the poplar nursery in Saxony a large section of the stool planting on a poor site was reported killed by this fungus.

Valsa nivea (imperfect stage, *Cytospora nivea* Sacc.), which is normally saprophytic on native *Populus tremula*, was reported in 1955 [9] as a potentially serious parasite on *tremula* × *tremuloides*

[9] Persson, Arne. *Kronenmykose der hybridaspe.* Phytopath. Ztschr. 24 (1): 5572. 1955.

hybrids in southwestern Sweden. This fungus has caused repeated and severe dieback in the crowns of hybrid aspens at Sofiero and Ekebo (Lat. 56). The dieback was not found in plantations of the same age and parentages at Mykinge and Brunsberg, 151 and 390 miles north of Ekebo, respectively. Climatic differences are assumed to be responsible for lack of infection in the more northerly plantations.

The first symptoms became apparent in the Sofiero and Ekebo plantations on 10- to 14-year-old trees. The disease is reported to be just as common and severe on vigorously growing trees as on poorly growing trees, but the progenies of different parentages vary in their susceptibility to this fungus.

Nectria spp.—There have been reports of severe losses from *Nectria coccinea* Fr., *sanguinella* Wa., and *N. galligena* Bres. *major* Wa. in a few localities. These fungi were reported to be responsible for the widespread death of poplars in the Lower Rhine region of Germany some 25 years ago. Only isolated cases—usually branch infections—were observed in the course of these studies, and at present this disease is not considered serious in Europe.

Hypoxylon crustaceum (Sow.) Nke. and *H. atropurpureum* Fr. have been reported on *Populus tremula* in Norway, but poplar foresters did not consider these pathogens a serious problem in aspen management.

Trunk scab

This name is used here as most descriptive of a spot necrosis of the bark, which occurs in widely separated regions of Europe. The cause of trunk scab is not known; but from observations and limited investigations it appears to be of pathogenic origin. Intensive research will be required to determine whether trunk scab is caused by a single organism, or whether different pathogens produce similar syndromes in the same or in different localities.

It is possible that trunk scab represents the effect of primary invaders that, having limited pathogenicity, produce only local lesions that the tree can overcome in 1 or 2 years. Where such a primary infection is followed by secondary pathogens the syndrome could be quite different; for example, cankers typical of the secondary pathogen could develop.

Small necrotic areas, usually brown or dark colored, appear on the bark of the trunk and produce an exudate during the growing season. These circular to elliptical areas, ½ inch to 1½ inches in diameter, heal over after 1 or 2 years but new spots continue to appear each year, giving the trunk a scabby appearance. The disease degrades the wood by producing brown-stain spots under the healed lesions, with or without included dead bark.

The individual defect areas extend only a short distance horizontally and are somewhat longer longitudinally. Scabby logs produce low-grade veneer because of the regularly spaced series of stained areas or holes where dead bark was enclosed. This syndrome is called "Braunfleckengrind" in Germany; in France it is referred to as the "maladie des taches brunes" and also as the

"disease of 'Robusta' in Chautagne"; and in Italy it is called "Batteriosi."

Trunk scab has been increasing in Germany since 1941. It was first observed on *P.* 'Robusta,' which appears to be most susceptible; but it also occurs on 'Regenerata,' 'Serotina,' and 'Berolinensis.' It affects trees on some of the best poplar sites. As early as 1950 the planting of 'Robusta' was prohibited in the state forests of North Baden and the Palatinate.

In France, trunk scab was observed only in the region of Chautagne. The forest pathologist at Nancy has isolated a number of bacteria and several fungi. Although the evidence points strongly to bacterial origin, he is of the opinion that *Phytophthora* should not be overlooked as a possible primary pathogen.

"Batteriosi" is a serious disease in Italy; it attacks even the most vigorous trees of highly susceptible clones. Fortunately there is clonal variation in resistance to this disease and susceptible clones, such as 'I–488,' are being replaced by resistant clones. Dr. Vivani of the Poplar Research Institute at Casale Monferrato has isolated several bacteria.

Trunk scab was also observed in plantations along the River Toradera near Hostalrich, Spain, and in a young plantation of *P.* 'Robusta' in the vicinity of Mons, Belgium. The 'Berolinensis' poplars on the Knutenberg Estate in Denmark, which were heavily infected with twig blight, also showed evidence of this syndrome.

Leaf Diseases

Leaf diseases, with the occasional exception of *Melampsora*, are usually of practical importance only in nursery plantings. The control of these diseases by spraying has become routine procedure in most progressive poplar nurseries in all countries. The spray schedule in the state poplar nurseries in Baden is typical of good European nursery practice. Bordeaux mixture is applied at approximately 6-week intervals. The first bordeaux spray is a 1-percent solution; later sprays are 2-percent.

Melampsora rust

Six species of *Melampsora* have been recognized in Europe: (1) *M. larici-populina* Kleb.; (2) *M. allii-populina* Kleb.; (3) *M. larici-tremulae* Kleb.; (4) *M. pinitorqua* Rostrup; (5) *M. Rostrupii* Wagner; and (6) *M. magnusiana* Wagner. The alternate hosts of the above species are *Larix* species (1,3), *Allium* species (2), *Pinus* species (4), *Mercurialis perennis* (5), *Chelidonium majus* and *Corydalis* species (6).

Melampsora is easily recognized by the bright orange-yellow spore masses on the underside of the leaves. Rust infection can completely defoliate young poplars by midsummer; and after a succession of heavy infestations for several years such trees may succumb to secondary pathogens.

The disease can be epidemic in older plantations. One such epidemic was observed in early September 1952 near Bellinzona,

Switzerland, in a plantation of about 200 trees approximately 12 years old. This was obviously a mixture of at least two clones that differ in their resistance to *Melampsora* rust. Six trees in this stand were practically rust free; one tree with a broader habit of growth showed medium rust infection; and all of the remaining trees were so heavily infected that they were practically defoliated. It is not known whether this plantation had been heavily attacked in previous years, but such epidemic infection in several successive years would certainly result in severe growth retardation of a monoclonal plantation.

Fortunately *Melampsora* can be dismissed as a serious threat to poplar culture because there are many inherently resistant clones. For every region there are now clones that are highly rust resistant, but the same clones are not necessarily resistant in other regions.

Leaf blotch

Waterman and Cash have given this name to a leaf disease caused by *Septotinia populiperda*.[10] The fungus produces small brown spots on the young leaves; these spots usually increase rapidly in size, soon become gray at the center, and have an irregular but sharply defined margin. The imperfect stage of this fungus had been collected in Latvia and described in 1932 under the name of *Septogloeum populiperdum* Moesz & Smarods.

Leaf blotch is not considered a serious disease in Europe. Nurserymen, when questioned on its occurrence in the past, remarked that it was easily controlled by routine spraying with bordeaux.

Localized, light infection was seen in the poplar nursery at Keppel, The Netherlands, in mid-July. There had been leaf-beetle feeding earlier in the season and the leaf blotch appeared to be associated with the beetle injury. Spraying for beetle control had apparently controlled the spread of leaf blotch. A few infected leaves were observed in the state poplar nursery at Harsefeld, Germany, in the poplar arboretum in Giritz, Switzerland, and on some of the oldest leaves on an occasional tree of clone *P*. 'I–455' in a nursery at Fronte, Italy. This disease is considered unimportant in Italy because it has appeared only in nurseries and in late summer. Noticeable infections have not been found in plantations.

Septogloese

A leaf disease called "Septogloese" in Germany was first observed in 1947 and described by Johannes in 1950[11] as caused by the fungus *Septogloeum populiperdum* sp. n. (This name had already been applied in 1932 to the imperfect stage of the leaf blotch fungus by Moesz & Smarods.) Septogloese does not appear to be

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[10] Waterman, A. M., and Cash, E. K. *Leaf blotch of poplars caused by a new species of Septotinia.* Mycologia 42: 374-384. 1950.

[11] Johannes, Heinrich. *Eine pappelsterben hervorgerufen durch den pilz Septogloeum populiperdum sp. n.* Deut. Pflanzenschutzdienst Nachrichtenbl. 2 (5): 67-69. 1950.

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the same disease as the leaf blotch reported by Waterman and Cash; the symptoms are different.

On the current year's growth of nursery stools and newly planted cuttings, leaves infected by the septogloese disease are reported first to become mottled (etiolated), then translucent, the green color being maintained only immediately adjacent to the veins. After 2 to 3 weeks the margins of the leaves begin to curl strongly upward. The fruiting bodies of the fungus—small white pustules about 1 sq. mm. in area—appear on the leaves during wet weather. Leaf fall is earlier than normal. In the following spring, the buds, after normal swelling, fail to develop and the stems die back. Whether the death of the stem is due to the leaf fungus or to a secondary parasite such as *Valsa* was still under investigation at the time of this survey.

In the poplar nursery at Harsefeld, German poplar foresters did not consider specimens of leaf blotch with symptoms typical of those described by Waterman and Cash to be the same disease they recognize as septogloese. They stated that they had observed this leaf blotch occasionally on nursery stock.

Other leaf diseases

There are other leaf diseases in Europe that up to the present time have not been of practical importance. Among these are *Taphrina aurea* (Pers.) Fr., which causes blisters and some leaf distortion; and leaf spots caused by species of *Phyllosticta*, *Marssoniana, and Septoria.*

Root Diseases

Root diseases have not been known to cause widespread damage in the poplar regions of Europe. Localized cases of severe reduction in growth or of high mortality have been reported as due to infection of the roots by *Armillaria mellea* (Vahl) Fr., *Rossellinia necatrix* (Hart.) Berl., *R. amphisphaerioides* L., *R. quercina* Hart., *R. aquila* (Fr.) de Not., *Pholiota aegerita*, *Botrytis cinerea* Pers., and other fungi. The crown gall bacterium, *Pseudomonas tumefaciens* Sm. et Towns, also occurs on poplar in Europe. These root diseases are usually thought to become serious only on heavy or wet soils.

Unidentified Diseases

Small, elongated, and slightly sunken stem cankers of unknown origin had been observed for several years previous to 1952 in test plantings of hybrid aspens at Ekebo, Sweden. In a planting of two rows each of different interspecific and intraspecific crosses, the *tremula* × *tremula* progenies were free of infection, and there was also a difference in the amount of infection on two adjacent hybrid progenies of the same female with different male parents.

The variability of infection in the adjacent trees was indicative of, but not proof of, inherent variation in susceptibility because in previous years all diseased trees had been removed as soon as they showed evidence of cankers, thus reducing the probability of

heavy and uniform exposure to infection. The same symptoms were observed on hybrid aspens in the experimental plots of the Swedish Match Company at Mykinge and of the Tree Breeding Station at Brunsberg. In these plantations, as at Ekebo, removal of diseased trees as soon as they were found had failed to eliminate the disease.

On a hybrid aspen at Brunsberg, a series of necrotic areas extended from an unidentified trunk canker at 6 feet above the ground to the base of the tree. These appeared to be infections from the original uppermost canker. The forester at Brunsberg stated that similar cankers are occasionally found on the native *P. tremula.*

There were dying Lombardy poplars in the vicinity of Stockholm, Sweden, with symptoms similar to the "vascular wilt" of this cultivar in the United States. Along the highway from Madrid to Burgos many columnar and fastigiate black poplars also exhibit this syndrome. There is evidence of clonal variation among these Spanish types not only in growth habit, but also in disease and insect resistance. Near Quintanar de la Mata, heavy infection of a leaf spot resembling *Septoria* was found on some trees whereas adjacent trees with somewhat different growth habit were free of infection.

In the arboretum at Horsholm, Denmark, a specimen of *P.* 'Bolleana' was in very poor condition; it had many dead branches and knobby swellings on the trunk that resembled the crown gall (*Pseudomonas tumefaciens* Sm. & Towns) reported by Cook on this poplar in the United States. The Asiatic Tacamahaca poplars in the arboretum appeared unhealthy, with many small dead branches and twigs. These Asiatic species seemed to be suffering from much the same condition—environmental or disease, or both—as in the botanical gardens in the northeastern United States.

A yellow mottling of the older leaves, locally called "mosaic," was observed in early September on nursery stock of *P.* 'Angulata' in northern Italy. It is said to occur only on young nursery trees and not on all clones, and is thought to be of physiological origin. It could be a deficiency symptom or a virus disease. "Mosaic" is not considered important.

Possible virus infections that result in premature leaf fall have been reported from Madrid, Spain. The symptoms have been described as similar to the virus diseases reported by Atanasoff on *P. balsamifera* in Bulgaria and by Perisic on "Canadian" poplar in Jugoslavia. Light green areas, which later become yellow and dry, appear along the veins of the leaves. There has been no experimental work in Spain to determine whether this "mosaic" condition is actually a virus infection.

A leaf spot that was similar to but not typical of leaf blotch was found in the state poplar nursery near Zaragoza. This apparently had occurred late in the season and by the end of September had affected relatively few leaves on the individual plants.

Wood Decay and Stains

Wood decay

Poplars are susceptible to numerous wood-decay fungi. These seldom attack trees under 40 years of age and rarely become serious on the best sites in trees less than 50 or 60 years old, the maximum rotation recommended in Europe. Since Aigeiros poplars are usually cut on a 12- to 35-year rotation, wood rots seldom cause appreciable economic loss.

Heartwood stains

Heartwood stains, in varying shades of dark brown, red, and orange, are common in all European poplar regions. The stained wood is sound; there is no decay and no evidence that the stain leads to eventual decay. It is uncertain whether the staining is of pathological or physiological origin. A dark-brown stain is the most frequent cause of log degrade in Great Britain. Some growers believe that it is correlated with variety or poor sites because it is often present in *P.* 'Serotina' and 'Robusta' and in trees on dry sandy soils or wet peaty soils.

Heartwood stain is common in the poplars grown in Italy. The color varies: in *P. alba* it is orange; in the Aigeiros hybrids it is red to dark brown. This problem is under investigation in several laboratories. At the Poplar Institute they have found that the bacterial count, pH, moisture content, and shrinkage on drying of the stained heartwood are higher than in normal white wood. No pathogen has yet been identified as the cause of staining. It commonly follows borer injury and is said to be more common on trees grown from cuttings than on seedlings.

In Italy logs used for pulpwood, lumber, or veneer for matches, core stock, and boxes are seldom downgraded because of stain. Where poplar is used for both bleached and unbleached groundwood pulp, the bolts are sorted and the unstained bolts are ground separately for unbleached pulp. Stained heartwood causes some manufacturing difficulties and waste in veneer use, but the shortage of suitable timber and the prevalence of stain has prevented industry from insisting on degrade.

For special uses, for face veneer, and for veneer and lumber in regions of Europe where other suitable species are available there is a severe degrade for stained heartwood. Industry is more interested than the grower is in research to eliminate this defect.

Significance for the United States

The history of poplar culture in Europe has demonstrated that disease can threaten the poplar culture of an entire region or even of an entire country.

It is apparent that climatic control of the pathogens limits their epidemic spread both in Europe and in the United States, but there may be racial or individual variation in the inherent viru-

lence or pathogenicity of the disease-producing fungi and bacteria. It is possible also that extensive planting of a single disease-resistant clone may, within a relatively short time, lead to the development of new strains of the pathogen to which that clone is no longer resistant.

Fortunately, because of the extremely variable germ plasm available in the genus *Populus*, it should be possible to produce hybrid clones that will be resistant to introduced diseases or new strains of native diseases more virulent than those presently in existence. Bacterial canker in northern Europe and the spring dieback and rust diseases in Italy would have eliminated profitable poplar culture in those regions if it had not been possible to select new inherently resistant clones. Continued vigilance, breeding, and selection will be necessary in order that the appearance of new diseases, or more virulent strains of older diseases, may be met with new resistant clones.

Monoclonal plantations are biologically unsound, because every ramet of a single clone has all the weaknesses as well as the excellence of the original ortet. A new disease or a more virulent variant of an unimportant native disease could wipe out extensive areas of a single clone in one epidemic. Random mixtures of 25 or more clones of different parentage will provide biological assurance against extensive disease losses because in such a stand every tree will not be equally susceptible to a new disease, or to a more virulent form of the native pathogen, against which the clones had not been tested.

Bacterial canker has not yet been reported in the United States. Spring dieback has long been recognized as common on our American aspens but it is not considered important on Aigeiros and Tacamahaca poplars. In 1956, Bruce W. Dance[12] reported that two different fungi are responsible for this disease on poplars in the United States and Canada. He concluded that the correct name of the fungus commonly found on aspen is most probably *Fusicladium tremulae* Frank (= *F. radiosum* (Lib.) Lind), perfect stage *Venturia tremulae* Aderhold. He has identified the fungus that has been reported only occasionally on Tacamahaca and Aigeiros poplars in the United States and Canada as *Pollaccia elegans* Serv. (= *Fusicladium radiosum* (Lib.) Lind var. *balsamiferae* J. J. Davis), perfect stage *Didymosphaeria populina* Vuill. (= *Venturia populina* (Vuill.) Fabricius).

Dothichiza, *Valsa*, and most European leaf diseases are present in this country, but it is possible that European forms may represent strains of different virulence than those in the United States. European experience indicates sufficient inherent variation to warrant the prediction that poplar clones resistant to practically all of these diseases can be produced by selective breeding.

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[12] Dance, Bruce W. *A leaf and twig blight of balsam poplar caused by Didymosphaeria populina Vuill., imperfect stage: Pollaccia elegans Serv.* Canada Dept. Agr. Forest Path. Lab. Interim Rpt. 70 pp., illus. 1956. [Processed.]

The best American poplar clones should be submitted to European poplar research stations for tests of their susceptibility or resistance to the most important European diseases. Clones resistant to European diseases should be brought into the United States and tested in different regions. They will be invaluable for planting and for breeding new resistant types if European diseases appear in this country.

Because of the serious risk of introducing new diseases or more virulent strains of native diseases, extreme care is essential in the importation of cuttings or nursery stock. Our present quarantine regulations prohibit the importation of cuttings or plants of poplars except through the Federal Plant Quarantine Station. Since other countries in this hemisphere do not have equally strict quarantine regulations, and because of the extensive introduction of European cutting stock into South America, we may expect that most European diseases will eventually reach this side of the Atlantic.

From the biological aspect, heartwood rots may be dismissed as of little importance; the rotation for poplar will be sufficiently short to eliminate any loss from wood rots. Heartwood stain, usually associated with so-called wetwood, is common in poplars in the United States. The dark-colored heartwood of *P. balsamifera* has been associated with bacterial infection, but in hybrid poplars we know little about the cause of stained heartwood.

It is the opinion of the author, based on observations during the past 30 years, that stains and wetwood are of pathogenic origin, that apparently various organisms are capable of producing similar symptoms, and that infection is probably through wounds, including the cut end of the original cutting. There is no conclusive research evidence available in Europe to invalidate this opinion.

It is apparent in all countries of Europe that poplars growing under adverse environmental conditions are particularly subject to disease. This is also true in the United States.

Trunk scab is a relatively new disease in Europe. Shade trees in the United States occasionally have small "bleeding" spots on the trunks, but since these poplars are not used for veneer it is not known whether this syndrome is associated with typical trunk-scab defects in the wood. It is possible that the American trunk-scab syndrome may become of considerable importance in some parts of the United States when hybrid poplars are grown extensively in commercial plantations.

The blanket indictment of the Tacamahaca poplars as highly susceptible to bacterial canker assumes a lack of individual variation for which there is insufficient justification. There are far too few clones of *P. trichocarpa*, *P. balsamifera*, and other balsam poplars in Europe to warrant the conclusion that there are no resistant Tacamahaca clones. The growth vigor of Tacamahaca hybrids, particularly when crossed with the Aigeiros poplars, justifies their continued breeding and selection.

The economic loss occasioned by epidemic diseases that kill trees or retard their growth is obvious. Heartwood stains and diseases

such as trunk scab, which apparently do not interfere with the growth of the affected trees, are nevertheless of serious economic importance. Stained heartwood is entirely suitable for bleached pulp but it cannot be used for the production of unbleached groundwood pulp. When used for veneer, stained heartwood associated with wetwood results in manufacturing difficulties due to excessive shrinkage, splitting, and warping. Aside from the manufacturing difficulties, it is doubtful whether stained heartwood, because of its color, could find a profitable market in the United States.

INSECTS

Of the many insects that infest poplars in Europe, only those of major economic importance and the most common species of minor importance are discussed here.

Boring Insects

Borers, particularly *Saperda*, are no doubt the most generally destructive poplar insects in Europe. There is as yet no good evidence for inherent resistance of individual clones to borer injury. Usually trees in poor vigor are more heavily infested than those growing vigorously, but occasional observations on excellent sites indicate that there are exceptions. Some boring insects can kill the infested trees; some may be associated with the spread of poplar diseases; and all cause more or less serious log degrade.

Saperda carcharias (L.), the large poplar longhorn beetle, is distributed throughout Europe, but heavy infestations are usually localized. In some localities it is the most serious insect pest of poplars. Since the full-grown larvae are more than ¼ inch in diameter, the larval tunnels in the wood are of large size, and the deeply boring larvae cause very serious degrade of lumber. The burrows are often infected with bacteria and fungi, which cause discoloration and additional product degrade.

There is some evidence that isolated trees and trees in rows are more heavily attacked than trees in plantations or in mixed stands. There are reports from Germany that border trees in plantations with filler species that increased stand density were more heavily attacked than trees inside the stand. There is evidence in Italy that poplars on dry sites are particularly susceptible to infestation.

For control, the introduction of a suitable fumigant such as carbon disulphide or carbon tetrachloride into the burrow is most frequently recommended. In Italy, a large match with fumigant at one end (called Antitarlo) is widely used for borer control. When these matches are pushed into the gallery and sealed with wet earth, the moisture of the tree releases the fumigant. Sanitation, by removing and burning infected wood, is always recommended. Spraying at the time the adult beetles are flying is practiced in a very few nurseries. It is not a practical control in plantations except under conditions of extremely heavy infestation.

Saperda populnea (L.), the small poplar longhorn beetle, infests the branches of large poplars or the stems of small trees. The injury caused by this beetle is similar to that caused by our native *S. concolor* Lec., the poplar gall Saperda. The eggs are laid in the bark of small branches or in the leader; and, as the larvae work between the bark and the wood, the branch develops gall-like swellings. The larvae eventually burrow into the center of the stem. This insect is most serious on young, poorly growing trees where it may infest the small stem or leader and result in eventual breakage at the weakened point. How much this insect is involved in spreading various canker diseases is not known. It seems probable, however, that it is an agent in the spread of bacterial canker and perhaps other fungus cankers.

Cossus cossus (L.), the goat moth, normally attacks other broadleaf trees but occasionally causes considerable damage to poplars. It is widely distributed; but, like the insects mentioned above, it may be serious only in certain localities. The goat moth seems to prefer isolated or widely spaced trees. Full-grown larvae may be as much as 3½ inches long. The larval stage extends over 2 or 3 years, and during this period the larvae continue to make larger and larger oval-shaped burrows in the wood. For control of this insect in The Netherlands, the entrance holes are plugged with cotton soaked in melted paradichlorbenzene.

Zeuzera pyrina (L.), the wood leopard moth, is reported numerous in the south of England; it injures poplars and other broadleaf species by attacking stems of small diameter. During the first season the larvae form a circular burrow in the outer sapwood, and during the second year they burrow a 6- to 8-inch vertical tunnel in the inner wood. Small stems often break off at the point of injury. This insect is not considered serious on the Continent.

Aegeria apiformis (Cl.), the hornet clearwing moth, is locally numerous and destructive in many parts of Europe from England to Italy. The young larvae feed first in the bark and cambium at the base of the trunk and then burrow into the wood of the stem and large roots. Trees that have been heavily infested for several years have the outer layers of wood honeycombed with the larval burrows and such trees tend to die back from the top or sometimes are killed outright.

Sciapteron tabaniformis Rott., the dusky clearwing moth, has been responsible for damage in Germany similar to that of the horned clearwing moth. It is also considered a destructive poplar pest in Italy.

Phytobia carbonaria (Zett.), the poplar cambium borer, is of considerable economic importance in Europe. The larvae bore long irregular burrows in the cambium, which become infected with bacteria, discolored, and covered by new wood. New tunnels are formed each year during an infestation, so the infested logs show concentric rings of small brown spots of varying width that are referred to as "pith flecks." The frass-filled tunnels cause serious log degrade because they constitute weak points in the wood and

make it unsuitable for the manufacture of matches or plywood. This insect is responsible for considerable economic loss in England.

Sternochetus lapathi (L.), the poplar and willow borer, is found in all of the poplar regions of Europe. It is usually associated with alder and willows but also attacks young poplars, and where infestation is heavy it can cause considerable damage. The hibernating insects resume feeding in the spring in the soft tissue of the inner bark and outer sapwood. Recently planted trees are particularly susceptible and are often killed by girdling.

Barypeithes pellucidus Boh. and *B. araneiformis* Schrank, short-snouted weevils, have been serious pests in nurseries where bracken compost was used. These insects infest the bark of young trees just above the ground level.

Cryphalus asperatus (Gyll.) infests the bark in the tops of poplars that are in poor vigor, often on trees attacked by other insects such as borers and defoliators. This insect may cause dieback and prepare the way for diseases in weakened trees.

Agrilus sexguttatus Brahm. This borer, related to the bronze birch borer, feeds in the cambium and weakens or kills the tree by partial or complete girdling. It has damaged large trees in Germany. The first sign of damage—discoloration of the outer leaves of the crown—is followed by early leaf fall and death of the tree.

Gypsonoma sp. Serious but very localized damage on young trees, particularly in the nursery, was observed in several localities. The insects feed in the buds before entering and hollowing the young shoots. In Germany this injury is laid to *G. acerina* Dup. In Italy, it is reported that there is more than one species of this insect on poplars. Since the insect overwinters in the soil it can be controlled by rotation of nursery areas with other crops.

Insects on the Leaves

Stilpnotia salicis (L.), the satin moth, is one of the most serious defoliators of poplars in southern Europe. The larvae first feed on the surface tissues but later consume all of the leaf except the midrib. This insect is periodically epidemic in Italy, locally or widespread. Heavy infestations usually result in complete defoliation. Normally defoliation is followed by the development of new leaves, in young trees by increased epicormic branching; since the growth rate is impaired, a succession of epidemic years results in serious damage.

Chrysomela populi L., the red poplarleaf beetle, and *C. tremulae* F., the aspenleaf beetle, are distributed over all of Europe. *C. populi* has caused serious defoliation in many localities from England to Italy. *C. tremulae* has been reported locally serious in Germany. The larvae skeletonize the leaves by feeding on the surface layers; and the adult beetles, which emerge during midsummer, cut irregular holes in the leaves.

Plagiodera versicolora (Laich.), the imported willow-leaf beetle, causes leaf damage similar to that described for *Chrysomela* spp.

Phratora spp. Three species of blue poplar-leaf beetles, *P. vulgatissima* (L.), *P. vitellinae* (L.), and *P. laticollis* Suffr., have been reported on poplars in Europe. These are small beetles 1/8 to 1/6 inch in length, of a blue-black metallic lustre with shades of bronze to green, particularly on the under side. Both the larvae and the adult beetles skeletonize the leaves. The adults cause additional damage by feeding on the very young shoots.

Epidemic infestations of leaf beetles in nurseries and recently established plantings are easily controlled by spraying. Heavy infestation in established plantations is apparently rare; no instances of serious plantation damage were brought to the author's attention.

Dicranura vinula (L.), the puss moth, has occasionally caused considerable defoliation of poplars in Italy and in England. The poplar kitten, *D. hermelina* Goeze, is of minor importance.

Cladus viminalis Fall, the poplar sawfly, and *Croesus septemtrionalis* L., the birch sawfly, occasionally cause local epidemic defoliation.

Hyphantria cunea (Drury), the fall webworm. At the 1952 International Poplar Commission meetings in Rome it was reported that the fall webworm, introduced into Yugoslavia from America, feeds on about 70 species of plants and is a very serious threat to poplar. It has two and possibly three generations per year in Yugoslavia. This introduced insect is spreading rapidly in Hungary and adjacent countries.

Leaf miners are distributed throughout all Europe but are generally considered of minor economic importance. There is no information on how damaging heavy infestations by *Phytagromyza populi* Kalt. (the poplar leaf miner), *Zeugophora scutellaris* Suffr., and other leaf miners may be to the growth and general health of poplars. In mid-August 1952 the author observed heavy infestations on *P.* ×*canescens* in the vicinity of Stockholm, Sweden, and on native aspen along the highway from Oslo, Norway, to the Swedish border. Infested trees were easily recognized by the gray appearance of the foliage.

Chalcoides aurata (Marsh.) and *C. helxines* (L.), flea beetles, are occasionally numerous enough in nursery plantings to require control by spraying.

Chaitophorus spp., poplar-leaf aphids. Two species, *C. populi* L. and *C. leucomela* Koch., are often found in large numbers on young leaves and shoots. Insects of the second species produce blisters on the leaves, and in England they are believed to be associated with infection by the fungus *Taphrina aurea*. Damage by leaf aphids is seldom serious.

Pemphigus spp., gall aphids. There are several species of aphids that are responsible for galls on the leaf blades or petioles. The most common of these belong to the genus *Pemphigus*. The leaf-gall aphid (*P. affinis* Koch.) produces galls on the leaf blades; *P. spirothecae* Passerini (the spiral-gall aphid) attacks the leaf petioles; and *P. bursarius* L. produces galls on the petioles and on the midrib of the leaf. In Spain, heavily infested columnar *P. nigra* types were growing in proximity to wide-spreading *P. nigra*

trees that were practically free of these aphids. This probably indicates clonal differences in susceptibility.

Harmandia loewi (Rübs.), the poplar gall-midge, produces galls on the leaf petioles. Aspen is reported to be the favorite host.

Byctiscus spp. Two species of these leaf rollers, *B. populi* (L.) and *B. betulae* (L.), have been reported responsible for some injury to poplar in Germany and Italy.

Insects on the Bark

The poplar-bark aphid (*Pterochlorus salignus* Gmelin.) and the willow-bark aphid (*Melanoxantherium salicis* L.) are widely distributed on the bark of poplars. Vigor of the tree is drastically curtailed by very heavy infestation and it is also possible that these insects may be a link in the spread of bacterial or fungous diseases. A woolly aphid (*Eriosoma*) is sometimes very heavy on poplars in southern Europe.

Phleomyzus passerinii Sign., the woolly aphid of poplar, is a serious pest in Italy. Heavy infestations have necessitated felling thousands of young trees. Dr. Vivani's studies indicate inherent variation in susceptibility to this insect. Clones *P.* 'I–28' and 'I–65' are highly susceptible. Clones 'I–214,' 'I–455,' the cultivar 'Carolin,' and *P. alba* are reported to be "exempt from infestation."

Cimbex variabilis Klg. The male of this sawfly gnaws the bark of poplar shoots, forming deep spiral grooves that sometimes completely girdle the young stems. Where the leader is completely girdled it usually breaks off before the end of the year. Occasional injury by this insect was observed in most of the poplar regions of Europe.

Significance for the United States

There is observational evidence in Europe of possible clonal variation in susceptibility to scale insects, leaf-gall aphids, and leaf beetles.[13] There is practically no evidence of inherent variation in susceptibility to boring insects.

In sufficiently large numbers, borers that feed in the cambium, such as *Agrilus* species, can kill even the largest trees by girdling. Wood borers that live in the bark in their early stages (*Saperda*) seldom kill large trees, but small trees may break off at the point of injury. These boring insects are particularly damaging because their large burrows may be so numerous that the timber can be used only for cellulose.

Leaf-feeding insects seldom cause high mortality even under epidemic conditions unless such epidemic feeding is continued for several years. But these insects are important because heavy defoliation seriously retards growth and may weaken the trees to such a degree that they are highly susceptible to attacks by other insects and diseases. Leaf aphids seldom cause appreciable damage

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[13] Research at the Northeastern Forest Experiment Station, U. S. Forest Service, has demonstrated inherent clonal variation in susceptibility to the Japanese beetle. (U. S. Dept. Agr. Yearbook 1949: 157.)

except in nursery plantings where they are easily controlled. Infestations of aphids and scale insects on the bark can be heavy enough to injure or kill plantation trees.

Several of the European poplar insects have been introduced into this country. The leopard moth (*Zeuzera pyrina*) is known to occur in the Northeastern States from Philadelphia to the northern border of Massachusetts. Although elms and maples are the favorite host plants in the United States, many other deciduous trees—including poplars—are attacked.

The horned clearwing moth has also been introduced into this country. It is widely distributed throughout the northern part of the United States and has been reported as the cause of severe injury to the large roots of poplars in the vicinity of Revere, Mass. There is also a native species of this insect that attacks poplars and willows; it is similar in appearance to the European species and is often mistaken for it.

The poplar and willow borer (*Sternochetus lapathi*) has become established from Maine west to Ontario and northern Wisconsin and south to Virginia. In recent years it has also been found in Washington and Idaho and it is said to be spreading to other areas. In the United States it attacks willow, alder, poplar, and birch. It has proved particularly serious to poplar and willow nursery stock and newly planted trees.

The short-snouted weevil, *Barypeithes pellucidus* Boh., is recognized as a strawberry pest in the United States.

The satin moth (*Stilpnotia salicis*) is now widely distributed in New England and the Maritime Provinces of Canada. It is also present in the Pacific Northwest and British Columbia west of the Cascade Range. It has been responsible for serious local defoliation of poplars in New England since it was first discovered in Massachusetts in 1920. The damage to poplars in New England is less serious than in southern Europe because in New England the insect produces only one generation per year.

Several European leaf beetles have also appeared in the United States: the European leaf beetles (*Chrysomela interrupta* F. and *C. tremulae* F.) and the imported willow leaf beetle (*Plagiodera versicolora* Laich.). The latter is now common in New England and extends into western New York and south to Virginia. Severe infestations in the United States, as in Europe, are not common; but when they do occur they cause considerable damage.

The European poplar sawfly (*Trichiocampus viminalis* Fall.) is now distributed from New Jersey through the Northeastern States into eastern Canada and west into British Columbia. Serious defoliation of shade and ornamental poplars has been reported.

The cottonwood leaf-mining beetle, *Zeugophora scutellaris* Suffr., has also been introduced into the United States.

In addition to the introduced pests we also have related native species of several important European poplar insects. The native poplar borer (*Saperda calcarata* Say) produces the same damage as the European longhorn poplar borer. *Saperda concolor* Lec., our native poplar-gall saperda, is similar in its attack on poplar

to the European *Saperda populnea* L. We also have native cambium miners in the United States, which cause damage similar to that of the European poplar cambium borer (*Phytobia*) on many species, including poplars. The bronze birch borer, *Agrilus anxius* Gory, attacks poplars and aspens in the United States with the same effect as the European member of this genus.

The giant American sawfly (*Cimbex americana* Leach) has been reported as occasionally infesting poplars. Although the European puss moth has not been reported in this country, we have native species on poplar that are related to this insect. There are three native species of gall aphids (*Pemphigus*) that attack poplars in the United States. Our native scale insects can cause serious injury to newly planted trees; in 1950 the author saw a young plantation in Michigan where the poplars were dying back from extremely heavy scale infestation.

Control of boring insects whose burrows open through the bark is possible by the injection of fumigants. Insects that feed under the bark, without such openings, can be controlled by spraying with DDT or other suitable insecticides when the insects are moving. Sanitation—removal and burning of infested branches and trees—is a practical control measure. Heavy infestations of leaf insects in plantations can be controlled by modern spraying methods. Control of leaf miners and aphids will seldom be necessary in plantations.

It is apparent in Europe that under conditions of intensive poplar culture both defoliator and boring insects can cause serious economic loss by degrading the timber, by killing the trees, or by severely retarding their growth. Control by modern methods, using mist blowers and airplanes for spraying or dusting, should be economically feasible for poplar plantations. Spraying for the control of boring insects will require exact knowledge of the life cycle of the insects because the control must be applied when the mature insects are moving and laying their eggs.

DAMAGE BY OTHER AGENTS

Mistletoe

Poplars in north-central France are often heavily parasitized by mistletoe (*Viscum album* L.). 'Regenerata' is particularly susceptible, but other cultivars are also attacked. Mistletoe can be unbelievably heavy on branches, and it also occurs on the upper part of the trunks. It is said that mistletoe does not appreciably retard growth, but the trunk wood penetrated by the haustoria cannot be used for veneer or lumber. This represents a relatively minor loss.

Environmental and Climatic Damage

Environmental conditions that reduce growth vigor are often the primary cause of decadence. Abnormally dry weather, sites that are too dry or too wet, soils that are infertile or too acid, and other environmental conditions such as the inhibiting effect of

sod, or crowding in plantings of a single clone, can condition the stand for further injury by insects and diseases. Borers and such facultative parasites as *Valsa* and *Dothichiza* may damage and kill many trees that have been weakened by adverse environment.

Poplars are susceptible to wind breakage, but on deep soils such damage is usually limited to the branches—rather than uprooting of the trees. Although recovery from mechanical injury is rapid on good sites, the broken branches provide possible entry points for fungi and bacteria. There is occasional local damage to tops and branches from the accumulation of snow, ice, or sleet. Local hailstorms can be extremely damaging. One- and 2-year-old plantations, on the Plaine de l'Orbe between Lake Neuchatel and Lake Geneva, were completely ruined by a hailstorm so severe that large branches of old trees were stripped of their bark.

Late spring frosts occasionally defoliate susceptible clones by killing the young leaves and shoots. Although there is seldom appreciable retardation of the current year's growth, there is no information about the extent to which such frost damage may facilitate invasion by insects, fungi, and bacteria. Frost damage can be avoided by the selection of frost-hardy clones.

Frost-crack on the lower trunk was observed in several countries. In some localities frost-crack damage is severe on susceptible clones—for example, on *Populus* 'Robusta' in northwestern Germany—but it is not generally serious throughout Europe.

Salt-spray injury is common on the Aigeiros poplars where they are used for windbreaks in maritime areas. *Populus* ×*canescens* is more resistant to such conditions and is used extensively in northwestern Germany and in Denmark for windbreaks in coastal areas.

Damage by Animals

Browsing damage by cattle and deer, and girdling by rabbits, are a menace in many parts of Europe where grazing and hunting are major sources of income from the land. Under such conditions each newly planted poplar is protected against cattle and deer by high woven-wire guards, by barbed wire loosely wrapped around the stem, or even by single-bar fences supported on 3 or 4 posts around each tree. Wire mesh or tar-paper guards are placed around each tree for protection against rabbits. Repellent sprays are sometimes used, but they are not generally considered reliable.

Significance for the United States

The environmental and climatic factors described as deleterious to poplars in Europe are equally damaging to poplars in this country. We have long recognized adverse site condition as the most important limiting factor for profitable poplar culture. For both biological and economic considerations, poplars should be planted only where site and climate are favorable for the maintenance of their normal growth rate.

The risk of wind, snow, ice, and hail damage must be considered in localities where trees in forest stands or in rows are subject to such injury. The rapid recovery of poplars from top breakage should be one of the factors included in the calculation of the economic risk.

Frost and frost-crack injury can be avoided by selection of clones tested for adaptability to the local climate.

On the basis of European experience, *P. ×canescens* cultivars should be selected for maritime exposures.

Poplars will require protection against animals, particularly deer and rabbits, where the animal population is high. Fencing, as practiced in Europe, will not be practical for extensive plantings under present conditions. The development of effective repellents offers the best possibilities for economical protection.

GROWTH AND YIELD

Aigeiros Poplars in Plantations

Comparable and precise data on growth and yield of Aigeiros poplars are rare in Europe. Variations among different clones designated under the same cultivar name, and inadequate information about planting stock, planting methods, and early care of plantations permit only empirical growth-and-yield comparisons among countries, cultivars, sites, spacings, and culture.

Excerpts from published data on yield of poplar in Spain, Italy, and Germany are presented in table 1. The close spacing and/or intensive culture on excellent soils are reported to produce average annual increments as high as 490 cubic feet per acre on 11- to 12-year rotations in Spain, and 500 cubic feet per acre on 25-year rotations in Italy. Average annual increment for 25-year rotations on site class I in Germany is reported as 392 cubic feet per acre; on site class III, as 120 cubic feet per acre.

Productivity of plantations examined by the author

More than 150 plantations were inspected by the author, but sufficient information for a reasonably accurate estimate of growth and yield was available for only 64 plantations (table 2). The ages listed in the table are the years since plantation establishment—1, 2, or 3 years less than the total age of the trees. Descriptions of site conditions and spacing for the individual plantations are given in the appendix, p. 119.

Summary by cultivar and country

The minimum, average, and maximum annual increments for cultivars and for countries, based on the 64 cases in table 2, are given in table 3. *P.* 'Marilandica' showed the lowest average annual increment. The fact that the 13 mixed plantings produced the highest average increment substantiates the biological soundness of clonal mixtures.

TABLE 1.—*Excerpts from published data on yield of poplar in Europe* [1]

Age (years)	Spain						Italy			
	Granada			Logrono			162 trees per acre		101 trees per acre	
	Trees per acre (average)	Total yield per acre	Average annual increment per acre	Trees per acre (average)	Total yield per acre	Average annual increment per acre	Total yield per acre	Average annual increment per acre	Total yield per acre	Average annual increment per acre
	No.	*Cu. ft.*	*Cu. ft.*	*No.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*
6	1,240	2,401	400	324	2,801	476	1,358	226	1,100	183
7	840	3,015	430	-----	-----	-----	1,686	241	1,436	205
8		3,658	457	-----	-----	-----	2,058	257	1,829	229
9		4,287	476	324	3,658	406	2,472	275	2,272	252
10		4,873	487	-----	-----	-----	2,929	293	2,772	277
11		5,416	492	-----	-----	-----	3,430	312	3,358	305
12		5,887	491	324	5,487	457	3,965	330	4,073	339
13	660	6,259	481	324	5,259	405	4,494	346	4,687	361
14		6,516	465	-----	-----	-----	5,009	358	5,402	38[illegible]
15		6,588	439	-----	-----	-----	5,502	367	6,130	409
16		6,602	413	-----	-----	-----	5,973	373	6,873	430
20	-----	-----	-----	253	7,802	390	7,674	384	9,660	483
25	-----	-----	-----	-----	-----	-----	9,288	372	12,518	501

Age (years)	Germany								
	Site class I			Site class II			Site class III		
	Trees per acre (average)	Total yield per acre	Average annual increment per acre	Trees per acre (average)	Total yield per acre	Average annual increment per acre	Trees per acre (average)	Total yield per acre	Average annual increment per acre
	No.	*Cu. ft.*	*Cu. ft.*	*No.*	*Cu. ft.*	*Cu. ft.*	*No.*	*Cu. ft.*	*Cu. ft.*
10	324	1,600	160	324	1,029	103	648	457	4[illegible]
15	162	4,687	312	162	2,286	152	324	1,486	99
20	81	7,545	377	81	3,458	173	162	2,515	126
25	40	9,803	392	40	4,544	182	81	3,344	134
30	40	11,375	379	40	5,373	179	40	3,915	130
40	40	15,176	379	40	7,759	194	40	4,844	121
50	40	19,334	387	40	9,746	195	40	6,002	120

[1] Data derived from the following reports:
Anonymous. *VIII Sesion de la Comision Internacional del Chopo en España.* Ministerio de Agricultura, Patrimonio Forestal de Estado. 460 pp., illus. Madrid. 1955.
Piccarolo, Giacomo. *Il pioppo. norme pratiche di cultirazione.* Ramo editoriale degli agricoltori. 130 pp., illus. Rome. 1952.
Hesmer, H. (editor). *Das pappelbuch.* Deut. Pappelverein. 304 pp., illus. Bonn. 1952.

The figures for The Netherlands may be somewhat low because the stands on which data were obtained in this country were all *P.* 'Marilandica,' a relatively slow-growing clone.[14] The high values for Italy and Spain are a reflection of the favorable climate, long growing season, highly fertile soils, and intensive culture.

[14] They are, however, higher than the 6.5 cubic meters "average annual increase per hectare" (93 cubic feet per acre) reported by G. Houtzagers in 1937.

TABLE 2.—*Productivity of European poplar plantations*

(Volume estimates based on peeled wood to 2.75-inch top diameter)

Case No. and cultivar [1]	Residual stand: Trees per acre	Residual stand: Age	Residual stand: Average d. b. h.	Residual stand: Average height	Residual stand: Stand volume per acre	Residual stand: Average annual increment per acre	Thinnings: Age	Thinnings: Volume removed per acre	Total: Volume	Total: Average annual increment per acre
	No.	*Yrs.*	*Ins.*	*Ft.*	*Cu. ft.*	*Cu. ft.*	*Yrs.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*
NETHERLANDS										
1. *P.* 'Marilandica'	68	21	15.4	81	2,501	119			2,501	119
2. Do	79	32	16.1	92	3,558	111			3,358	111
3. Do	55	35	18.7	95	3,344	96			3,344	96
4. Do	53	32	17.3	96	2,844	89	27	(1)	+2,844	+89
BELGIUM										
5. 'Regenerata'	100	16	12.2	72	2,115	132	10	972	3,087	193
6. Do	80	21	13.4	79	2,201	105	10	272		
							11	457		
							17	400	3,330	158
7. 'Robusta'		18			2,415	134	(1)	(1)	+2,415	+134
GERMANY										
8. *P.* ×*canadensis*		56	24.4	121	[2] 5,059	90			5,059	90
9. Do		56	33.8	125	[2] 9,932	177			9,932	177
10. Unnamed	83	10	8.7	51	672	67			672	67
11. Do	63	11	11.8	54	1,015	92			1,015	92
12. Do	53	32	20.5	107	4,201	131			4,201	131
13. Do	115	12	11.8	75	2,444	204			2,444	204
14. Do	115	16	16.5	89	5,259	329			5,259	329
15. Do	53	23	23.2	98	5,016	218			5,016	218
16. 'Robusta'	260	12	9.4	62	3,115	260	(1)	(1)	+3,115	+260
17. Do	132	13	9.4	71	1,729	133			1,729	133
18. Do	337	15	[3] 9.4	[3] 69	4,287	286			4,287	286
19. Do	146	25	16.5	95	7,102	284			7,102	284
20. Do	162	17	12.6	72	3,658	215			3,658	215
21. Do	700	13	5.1	48	1,972	152			1,972	152
22. Do	214	13	6.3	48	900	69			900	69
23. Do		14	7.7	54	1,572	112	10	43		
							13	257	1,872	134
24A. Do	223	14	11.4	62	3,773	270	(1)	(1)	+3,773	+270
24B. Do	223	14	7.1	52	1,258	90	(1)	(1)	+1,258	+90
25. Do	135	17	9.4	69	1,715	101	14	527	2,242	132
26. 'Regenerata'	42	24	19.7	82	2,529	105			2,529	105
27. Do	115	28			3,450	123			3,450	123
28. 'Regenerata Harff'		54	[4] 47	[4] 148	10,260	381			10,260	190
29. Do		55	[4] 47	[4] 148	10,260	374			10,260	187
30. Do		31	28	112	[5] 6,040	390			6,040	195
31. 'Marilandica'	45	37	22.8	102	4,216	114	(1)	(1)		
							32	1,715	+5,931	+160
32. Unnamed	28	41	26.1	125	3,973	97	(1)	1,043	5,016	122
	15	57	33.3	140	3,947	69	(1)	2,715	7,705	135
33. Do	20	60	34.2	135	5,277	88	(1)	(1)	+5,277	+88
34. 'Marilandica'	26	57	30.4	125	5,073	89	(1)	(1)	+5,073	+89
35. 'Regenerata'	40	41	22.4	125	4,344	106	(1)	(1)	+4,344	+106
36. *P.* ×*canadensis*	71	22	15.3	100	3,643	166	(1)	1,143	4,786	218
37. Do	34	50			10,003	200			10,003	200

TABLE 2.—*Productivity of European poplar plantations*—Continued

GERMANY—Continued

Case No. and cultivar[1]	Residual stand: Trees per acre	Residual stand: Age	Residual stand: Average d. b. h.	Residual stand: Average height	Residual stand: Stand volume per acre	Residual stand: Average annual increment per acre	Thinnings: Age	Thinnings: Volume removed per acre	Total: Volume	Total: Average annual increment per acre
	No.	Yrs.	Ins.	Ft.	Cu. ft.	Cu. ft.	Yrs.	Cu. ft.	Cu. ft.	Cu. ft.
38. *P.* ×*canadensis*	32	60	39.4	138	11,432	191	----	---------	11,432	191
39. *P.* ×*canadensis* mixture	140	17	13.0	89	4,301	253	(1)	543	4,844	285
40. Do	121	18	11.8	85	3,044	169	(1)	(1)	+3,044	+169
41. Do	101	28	16.5	95	4,930	176	(1)	(1)	+4,930	+176
42. Do	101	38	18.1	102	6,202	163	(1)	4,001	10,203	268
FRANCE										
43. *P.* 'Virginiana'	83	13	14.6	75	2,572	198	------	---------	2,572	198
44. 'Robusta'	83	20	18.5	82	4,373	219	------	---------	4,373	219
45. 'Serotina de Champagne'	83	14	8.3	49	612	44	------	---------	612	44
46. 'Regenerata', 'Robusta'	87	24	11.8	66	1,629	68	------	---------	1,629	68
47. 'Virginiana'	42	28	19.3	98	2,815	100	------	---------	2,815	100
48. Do	75	45	22.0	126	8,088	180	------	---------	8,088	180
49. 'Robusta'	81	20	14.6	105	3,544	177	------	---------	3,544	177
50. Do	253	18	9.0	70	3,044	169	------	---------	3,044	169
51. 'Italica' mixture	------	25	--------	--------	4,501	180	------	---------	4,501	180
52. Do	269	20	11.0	59	4,087	204	------	---------	4,087	204
53. 'Regenerata', 'Robusta'	112	20	13.8	75	3,144	157	------	---------	3,144	157
SWITZERLAND										
54. *P.* ×*canadensis* mixture	------	55	--------	--------	9,289	169	(1)	(1)	+9,289	+169
ITALY										
55. *P.* 'I-214'	115	5	8.0	50	770	154	------	---------	770	154
56. Do	115	7	6.0	53	486	69	------	---------	486	69
57. Do	115	7	10.0	59	1,386	198	------	---------	1,386	198
58. Do	115	1	15.0	98	4,930	448	------	---------	4,930	448
59. Mixture of clones	130	16	16.0	112	6,859	429	------	---------	6,859	429
60. 'I-214'	128	6	8.0	65	1,128	188	------	---------	1,128	188
61. 'Monilifera' mixture	162	9	9.0	98	3,087	343	------	---------	3,087	343
62. Mixture of clones	117	17	17.7	108	7,174	422	------	---------	7,174	422
SPAIN										
63. Unnamed	253	5	8.3	49	1,872	374	------	---------	1,872	374
64. Mixture of clones	162	11	10.0	70	2,229	203	------	---------	2,229	203

[1] One or more thinnings were made but data were not available on age of thinning or volume removed.
[2] Volume estimates based on 40 trees per acre.
[3] These values are for inside trees only; border trees average 14.2 inches in d. b. h. and 79 feet in height.
[4] Measurements of the best trees; volume estimates based on 20 trees per acre.
[5] Volume estimate based on 40 trees per acre.

TABLE 3.—*Summary of poplar growth by cultivar and country*

Item	Cases	Annual increment per acre [1]		
		Minimum	Average	Maximum
Cultivar:	*No.*	*Cu. ft.*	*Cu. ft.*	*Cu. ft.*
'Marilandica'	6	+89	+111	160
'Regenerata'	5	105	+137	193
'Virginiana'	3	100	159	198
'Robusta'	15	69	+182	286
Unnamed	9	67	+176	374
P. ×canadensis	5	90	175	218
'Regenerata Harff'	3	187	191	195
'I-214'	5	69	211	448
Mixed plantings	13	68	+236	429
Country:				
The Netherlands	4	+89	+104	119
France	11	44	154	219
Belgium	3	+134	+162	193
Switzerland	1	----------	169	----------
Germany	37	67	+171	329
Italy	8	69	281	448
Spain	2	203	288	374

[1] Based on the annual increments listed in table 2.

An owner of three poplar estates of approximately 100 acres each in the Seine Valley in France has obtained the following yields:

Soil:	*Rotation (years)*	*Total yield per acre (cu. ft.)*	*Average annual increment per acre (cu. ft.)*
Very best	25	6, 300	252
Good and deep	25	4, 650	186
Good but shallow (average)	30	1, 860	62

These figures are not inconsistent with the average for the 11 French plantations listed in table 3; but the 252 cubic feet of annual increment on the very best sites on these estates in the Seine Valley does exceed the maximum for the 11 plantations listed in the table. It is not so high as the maximum for Germany.

Comparisons of site, culture, spacing, and age

Site.—The broad site classifications "good" and "poor" are based on the author's observations, including soil borings where necessary and feasible, and information provided by the local foresters or owners. Enough information was available for classing 38 cases as good and 7 cases as poor (table 4). The difference in average productivity was 106 cubic feet per acre per year. Statistically, this was highly significant.

Culture.—To gage the effects of culture, 32 stands that were given at least 1 year of cultivation or intercropping after planting, or were established on sites with a forest floor, were compared

with 24 stands in which the poplars were planted in grass without cultivation (table 4). The difference in average annual increment, 32 cubic feet per acre, was not statistically significant.

Grass retards the growth of newly planted poplars during the first years after planting. This inhibiting effect is particularly serious because the weakly growing trees are highly susceptible to adverse climatic conditions, diseases, and insects. On deep soils the trees that have escaped serious injury usually recover their normal growth rate after 3 to 5 years. It is most probable that these growth-and-yield data are not sufficiently precise for evaluating this early reduction in productivity because they are confounded with other unknown or unmeasurable environmental factors.

Spacing.—For comparing the effect of spacing on productivity, the data were grouped into three classes based on the average growing space available per tree: (1) less than 269 square feet (approximately 16.4 by 16.4 feet); (2) 269 to 538 square feet; and (3) more than 538 square feet (approximately 23.3 by 23.3 feet). Comparisons of the average annual increments of these spacing classes are listed in table 4.

The difference in average annual increment between spacings of less than 269 square feet and more than 538 square feet is statistically significant. The difference between 538 square feet and 269 to 538 square feet falls just short of statistical significance.

The average annual increment for spacings of more than 23.3 by 23.3 feet is 64 and 54 cubic feet per acre less than with closer spacings. This loss of more than 25 percent in productivity reflects incomplete use of the total available growing space.

Age.—The age comparisons for Italy and Spain were analyzed separately (table 4) because of the short rotations in these countries. The difference of 155 cubic feet per acre per year in favor of the 10- to 19-year-old plantations indicates the soundness of Italian and Spanish recommendations for rotations of 20 to 25 years.

The data for all cases except Italy and Spain (table 4) show the average annual increment of three age groups to be as follows:

Years:	*Average age*	*Cubic feet per acre per year*
10–19	14.5	173+
20–29	23.3	167+
29+	46.2	149+

Although the differences among these age groups are not statistically significant on the basis of these data, these figures do suggest that the maximum volume productivity in the observed plantations was reached some time between the 14th and 23d years. Although there is a further decrease in average annual increment between the 23d and 46th years, this is not large enough to preclude the profitable production of large, high-quality timber. The high price of large high-quality veneer logs in Europe will provide a good profit on longer rotations.

TABLE 4.—*Comparisons to show effect of site, culture, spacing, and age*

Item	Cases	Average annual increment per acre	Difference between means; computed value of t; value of t needed for significance
SITE			
	No.	*Cu. ft.*	
Good sites	38	205	Difference = 106 cubic feet/acre $t=2.82$ [1] t (for $P=0.01$) = 2.69
Poor sites	7	99	
CULTURE			
Forest, or early cultivation or intercropping	32	+191	Difference = 32+ cubic feet/acre $t=1.27$ t (for $P=0.05$) = 2.00
Poplars in grass	24	+159	
SPACING: GROWING SPACE			
269 to 538 square feet	26	+201	Difference = 10+ cubic feet/acre $t=0.34$ t (for $P=0.05$) = 2.01
Less than 269 square feet	18	+191	
269 to 538 square feet	26	+201	Difference = 64+ cubic feet/acre $t=1.99$ t (for $P=0.05$) = 2.02
More than 538 square feet	13	+137	
Less than 269 square feet	18	+191	Difference = 54+ cubic feet/acre $t=2.25$ [2] t (for $P=0.05$) = 2.04
More than 538 square feet	13	+137	
AGE			
Italy and Spain:			
Less than 10 years (average 6.5 years)	6	221	Difference = 155 cubic feet/acre $t=2.06$ t (for $P=0.05$) = 2.26
10 to 19 years (average 13.8 years)	4	376	
All cases except Italy and Spain:			
10 to 19 years (average 14.5 years)	21	+173	Difference = 6+ cubic feet/acre $t=0.23$ t (for $P=0.05$) = 2.04
20 to 29 years (average 23.3 years)	15	+167	
10 to 19 years (average 14.5 years)	21	+173	Difference = 24+ cubic feet/acre $t=0.99$ t (for $P=0.05$) = 2.02
More than 29 years (average 46.2 years)	20	+149	
20 to 29 years (average 23.3 years)	15	+167	Difference = 18+ cubic feet/acre $t=1.01$ t (for $P=0.05$) = 2.04
More than 29 years (average 46.2 years)	20	+149	

[1] Significant at 1-percent level.
[2] Significant at 5-percent level.

Aigeiros Poplars in Row Plantings

There are thousands of row plantings in Europe (fig. 28 and fig. 29). In the poplar regions of France and Italy it was possible to inspect 10 to 20 such plantings in a day's drive. Unfortunately, information sufficient for comparative evaluation of their productivity was seldom available. Data on 23 of the more than 300 row plantings examined by the author are presented in table 5. A description of the plantings is given in the appendix, p. 123.

Estimation of productivity of row plantings on a per-acre basis is impractical; therefore volume and average annual increment have been estimated on the basis of 100 feet of row.

TABLE 5.—*Productivity of European poplar in row plantings*

(Volume estimates based on peeled wood to 2.75-inch top diameter)

Case No. and cultivar	Spacing	Age	Average tree: Diameter breast high	Average tree: Height	Average tree: Volume	Average tree: Average annual increment	100 feet of row: Trees	100 feet of row: Volume	100 feet of row: Annual increment
	Ft.	*Yrs.*	*Ins.*	*Ft.*	*Cu. ft.*	*Cu. ft.*	*No.*	*Cu. ft.*	*Cu. ft.*
65. *P.* 'Heidemij'	15	35	31.5	90	171	4.9	6.7	1,146	32.7
66A. 'Serotina'	7	15	11.8	66	19	1.3	14.3	272	18.1
66B. Do	7	16	12.0	69	20	1.3	14.3	286	17.9
66C. Unnamed	7	17	16.1	75	38	2.2	14.3	543	31.9
67. 'Robusta'	16	13	12.6	66	21	1.6	6.3	132	10.2
68. Do	21	13	13.4	69	24	1.8	4.8	115	8.8
69. Do	13	15	11.0	69	17	1.1	7.7	131	8.7
70. Do.[1]	33	18	18.5	79	52	2.9	3.0	156	8.7
70. *P. alba*	33	18	11.4	66	18	1.0	3.0	54	3.0
71. 'Robusta'	20	18	15.0	82	35	1.9	5.0	175	9.7
72. Do	26	18	17.3	75	44	2.4	3.8	167	9.3
73. Do	23	19	13.1	77	24	1.3	4.3	103	5.4
74. Do	20	20	15.4	79	36	1.8	5.0	180	9.0
75. 'Serotina'	20	20	15.7	75	36	1.8	5.0	180	9.0
76. Do	21	22	17.7	75	46	2.1	4.8	221	10.0
77. Unnamed	23	23	18.5	100	63	2.7	4.3	271	11.8
78. Do	33	38	26.0	100	122	3.2	3.0	366	9.6
79. Do	49	60	43.2	131	426	7.1	2.0	852	14.2
80. Mixture of clones	28	23	22.0	82	75	3.3	3.6	270	11.7
81. 'Serotina'	13	19	17.7	79	47	2.5	7.7	362	19.1
82. 'Robusta'	25	29	25.2	110	127	4.4	4.0	508	17.5
83. Do	25	28	21.3	90	74	2.6	4.0	296	10.6
84. 'Regenerata'	25	28	23.2	90	89	3.2	4.0	356	12.7
85. 'Serotina'[2]	[3] 16	27	14.6	82	34	1.3	6.3	214	7.9
	[4] 16	27	15.7	82	38	1.4	6.3	239	8.9

[1] Mixed planting of *Populus alba* and 'Robusta'. The data on *P. alba* are included for comparison of its slower growth rate with that of 'Robusta'; they are not included in the computations or comparisons in the text.

[2] 4-row planting, rows 20 feet apart.

[3] Trees in inside rows.

[4] Trees in outside rows.

Average, minimum, and maximum yields

These data should be used only for empirical comparisons. They are too meager to warrant rigorous statistical analysis.

The average annual increment for all cases is 13.8 cubic feet per 100-foot row, and the average age is 22.5 years. This is an

NED. HEIDEMIJ. (ARNHEM) photo

FIGURE 28.—Row planting of *Populus* 'Marilandica' in The Netherlands. The crooked stems are characteristic of this cultivar. Much timber in The Netherlands is grown along the roads and highways.

Photo by G. HOUTZAGERS

FIGURE 29.—Roadside planting of *Populus* 'Heidemij' on the new Northeast Polder, The Netherlands, underplanted with alder to be managed as coppice. The alder had been cut a year before the photograph was taken.

average total yield of 310 cubic feet (approximately 3.4 cords) per 100-foot row in 22.5 years. Minimum production (case 73) is 103 cubic feet (approximately 1.1 cords) per 100-foot row in 19 years. Maximum productivity (case 65) is 1,146 cubic feet (approximately 13 cords) per 100-foot row in 35 years.

Comparisons of cultivar, age, and spacing

Cultivars.—The average annual increment per 100-foot row for the cultivars represented in these row plantings is as follows:

Cultivar:	Cases (no.)	Increment (cu. ft.)
'Robusta'	10	9.8
Mixed clones	1	11.7
'Regenerata'	1	12.7
'Serotina'	7	13.4
Unnamed	4	16.9
'Heidemij'	1	32.7

TABLE 6.—*Productivity of aspen stands on good sites in Sweden*

Type of stand	Stands	Average annual increment of aspen per acre	Trees per acre [1]			Basal area per acre [1]		
			Aspen	Associates	Total	Aspen	Associates	Total
33- and 34-year-old stands of aspen and—	*No.*	*Cu. ft.*	*No.*	*No.*	*No.*	*Sq. ft.*	*Sq. ft.*	*Sq. ft.*
Spruce	2	75	2,660	1,582	4,242	92	31	123
Spruce, birch, alder, ash	2	56	2,725	542	3,267	76	12	88
43- and 44-year-old stands of aspen and—								
Spruce	2	91	1,734	877	2,611	106	9	115
Spruce, birch, alder, ash	2	69	1,600	220	1,820	79	7	86
51- and 52-year-old stands of aspen and—								
Spruce	1	101	1,213	3,315	4,528	106	22	128
Spruce, birch, alder, ash	1	71	1,025	1,870	2,895	72	18	90

[1] Figures for number of trees and basal areas are the totals for the residual stand plus trees removed in intermediate cuttings. Trees lost through natural mortality are not included.

Age.—The average productivity per 100-foot row for each of four age groups is as follows:

Average age (yrs.):	Cases (*no.*)	Average annual increment (*cu. ft.*)	Total volume (*cu. ft.*)
16.5 (13–19)	11	13.4	221
24.7 (22–29)	9	10.9	269
36.5 (35–38)	2	21.2	774
60	1	14.2	852

Spacing.—The average annual increments per 100-foot row for three spacing classes are as follows:

Average spacing (ft.):	Cases (*no.*)	Increment (*cu. ft.*)
12 (7–16)	8	17.5
23 (20–28)	12	10.5
38 (33–49)	3	10.8

The d. b. h., height, and volume data for the average tree do not indicate any trend toward reduction in growth rate due to the closer spacings in these row plantings. The larger number of trees per 100-foot row is primarily responsible for the higher average yield of the 7- to 16-foot spacings. The effect of close spacing on log quality—crook, lean, eccentric growth—has been discussed in an earlier section.

Native Aspen in Scandinavia

The intensity of aspen management varies widely in Sweden and Norway. The following yields are frequently cited [15] as overall averages for aspen at 50 years of age:

Site class I: Total production—2,860 cu. ft./acre (57 cu. ft./acre/year).
Site class II: Total production—2,144 cu. ft./acre (43 cu. ft./acre/year).

The productivity of well-managed stands in southern Scandinavia is much higher than these overall averages. The native aspen stands in Skaraborg shire, between latitudes 58° and 59° (the latitude of northern Manitoba), are considered to rank among the best in Sweden. The information in table 6, based on sample areas on sites rated as good for aspen, is from a forest estate located between Vener Lake and Vetter Lake in Skaraborg.

The average annual increments, from 56 to 101 cubic feet per acre (0.62 to 1.1 cords), reflect intensive management. The consistently higher yields of aspen in association with spruce—in contrast to the lower yields in mixture with spruce, birch, alder, and ash—is particularly noteworthy. Since the sites are rated as good, the differences in yields between stands of practically identical ages might be predicated on differences in stand density, species composition, or both.

Differences between stands of similar ages in the number of aspens per acre are hardly sufficient to account for the higher yields and larger basal areas in the aspen-spruce association. The number of trees and the basal areas of the associated species are consistently lower in the aspen-spruce-birch-alder-ash association. There is, therefore, little or no justification for attributing the poorer growth of aspen in association with spruce, birch, alder, and ash to unfavorable stand density or to the tree size of the associated species. It is possible, if not probable, that species composition—the individual or collective effect of birch, alder, and ash—is responsible for the lower aspen yields.

Significance for the United States

Aigeiros poplars.—There is no doubt whatever that with intensive management we can obtain, and perhaps even surpass, the present European yields of Aigeiros poplars under similar climatic and site conditions. This will not necessarily require such extremely intensive culture as agricultural intercropping. We have one of the most productive natural poplar species, the American cottonwood, distributed throughout the eastern United States from Canada to the Gulf of Mexico. And we have under test many hybrids potentially as productive as any in Europe.

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[15] Barth, Agnar. *Aspen. Dens kultur og behandling for kvalitetsproduksjon.* Fra ingeniør F. H. Frølichs fond for aspeskogsbrukets fremme Nr. 1. 87 pp., illus. Oslo. 1942.

The fast-growing Aigeiros cultivars that are in general use in Europe today stem from hybrids between the American cottonwood and the European black poplar. The cottonwood (*P. deltoides*) is the more productive of these two parent species. It produces its highest yields on the batture (overflow) lands of the lower Mississippi River Valley. In fully stocked natural stands, annual yields of 4 to 5 cords—approximately 360 to 450 cubic feet—per acre have been reported [16] as not uncommon. The average yield of fully stocked natural stands on these batture lands has been estimated to be 5,000 cubic feet at 20 years, 250 cubic feet per acre per year. The following yields per acre have been estimated for fully stocked natural stands on good sites in the Mississippi Delta region:[17]

At 5 years: 6 cords (approximately 540 cubic feet) (108 cubic feet/acre/year).
At 10 years: 24 cords (approximately 2,160 cubic feet) (216 cubic feet/acre/year).
At 15 years: 50 cords (approximately 4,500 cubic feet) (300 cubic feet/acre/year).

These estimates are for unmanaged stands. Managed stands, properly and regularly thinned, would exceed these yields. The use of élite native clones, selected for rapid growth, would further increase the productivity of this species in managed plantations. And the fact that most European hybrids exhibit hybrid vigor provides a sound basis for predicting that hybrids, bred and selected for our southern environments, would exceed the productivity of the fastest growing native clones in the optimum range of this species.

The yield of cottonwood is somewhat lower in the northern part of its range and on sites that are less fertile and drier than river-bottom lands subject to periodic overflow. Under such environmental conditions the European hybrids may be better than the natural species. The best European cultivars should be introduced, through strict plant quarantine, for the reasons mentioned in earlier sections. They would require at least 10 to 15 years of well-designed field testing before they could be safely recommended for commercial planting in this country.

There is no indication that the European cultivars will be more productive, at least in the northern half of the United States, than the best of the hybrids now under countrywide test by the Northeastern Forest Experiment Station. These hybrids were originally selected for survival and growth under New England's climatic conditions. The growth of the best hybrids in the original test plantations, established in 1927 and 1928 in western Maine, justifies the prediction of a minimum total yield of 40 cords (3,600

[16] Williamson, A. W. *Cottonwood in the Mississippi Valley.* U. S. Dept. Agr. Bul. 24, 62 pp., illus. 1913.

[17] Bull, Henry, and Muntz, H. H. *Planting cottonwood on bottom lands.* Miss. Agr. Expt. Sta. Bul. 391, 18 pp., illus. 1943.

cubic feet) of pulpwood per acre in 15 years (240 cubic feet per acre per year) with reasonably good plantation management on suitable upland soils.

Under intensive management on the best soils the yield could be much more. Open-grown hybrids on excellent sites in Massachusetts and Pennsylvania have reached 22 inches d. b. h. in 11 years. In row plantings, spaced 25 feet, the yield of such hybrids in 11 years would be approximately 240 cubic feet (or 21.8 cubic feet per year) per 100-foot row. This is comparable to the best growth of Aigeiros cultivars in European row plantings.

The higher average yield of clonal mixtures in European plantations strengthens the case against monoclonal stands.

Aspen.—Within its commercial range, the timber form and productivity of our quaking aspen (*P. tremuloides*) is fully as good as that of the European aspen. Studies in the Lake States have shown that at 50 years on good sites a yield of 47 cords per acre (84 cubic feet per acre per year) may be expected for unmanaged stands. The results of thinning experiments indicate that intensive management could raise the average annual increment on good sites well above 100 cubic feet per acre in less than a 50-year rotation.

Species hybridization, and possibly also racial hybridization, can be expected to provide new types of greater productivity than the native species.

Effect of associated species.—There is practically no experimental evidence on the possible inhibiting effect of associated species of forest trees on the growth of poplars. All poplar species and hybrids are classified as very intolerant to shading. Nevertheless, we have an experimental area on which root sprouts of hybrid poplars have survived for periods of 4 to 7 years under the complete shade of loblolly pines planted 2 by 4 feet apart. These poplars outgrew and overtopped the loblolly when the pines were between 10 to 18 feet in height. This indicates far greater tolerance to shading than is generally accorded to poplars; and, most significantly, it indicates absence of any seriously deleterious root interactions between the poplars and the pines.

On the other hand, during the past 30 years the author has observed plantings on equally good sites where the growth of poplars was severely retarded by brush and hardwood sprout growth that was mowed periodically to prevent overtopping the poplars. Since the poplars had full sunlight, the growth-retarding effect was apparently due to inimical root interactions. Experiments to provide answers to this problem are basic to any future recommendations for the management of Aigeiros species and hybrids, and of aspen, in mixture with other species.

On suitable soils hybrid poplars can be managed to produce a greater volume of wood per acre, and larger individual trees, in a shorter period of time than any other timber tree in the United States. Large-diameter, knot-free, high-quality veneer logs can be produced in 15 to 25 years. We have no other timber tree that can equal this combination of growth and wood-quality potential. But from the economic aspect such production must have commercial use and reliable markets.

On the basis of present utilization, covered in the next section, it is safe to predict that in areas where an adequate supply can be maintained, the demand for poplar logs will keep pace with greatly expanded production. The problem of marketing small local production has been discussed in the introduction.

The establishment of hybrid poplar plantations and their management for maximum quantity and quality production will require a somewhat higher investment than plantations of biologically less exacting timber species. But the yields on relatively short rotations will be sufficiently high to warrant the expectation of profitable dividends on the added investment.

For industrial and nonfarmer ownerships, poplar production will necessitate a cash investment that will require the maximum use of mechanical equipment to reduce to a minimum the use of hand labor. For the farmer, the investment in poplar production will usually represent the use of machinery available on the farm, his own supervision and labor, and the labor of his regular farmhands. This will seldom interfere with agricultural activities because most of the work with poplars can be handled as off-season jobs.

CHARACTERISTICS OF THE WOOD

The anatomical characteristics of some species of poplar are sufficiently distinct for reasonably accurate identification, but the wood of individual Aigeiros hybrids cannot be identified by this means. Yet there is evidence of differences among the wood of the various cultivars in their use requirements, the qualities and properties important for their conversion and use for veneer, lumber, pulp, and particularly for specialty products. These differences are due both to inherent variations and to the effect of environmental conditions under which the trees were grown.

Trees of the same cultivar are reliably reported to have different wood qualities, depending on the rate of growth, spacing, and possibly other environmental conditions. Research is under way in several European laboratories to evaluate the technical qualities and properties of the cultivars in common use. These studies are complicated by the fact that the same cultivar name may be applied to several clones, by the complex nature of some wood qualities, and by the effect of environmental factors that cannot be accurately measured and correlated with wood quality.

The following characteristics and qualities apply, in general, to the wood of the poplars grown in Europe. The wood is light in weight, light-colored—unless heartwood stain is present, free of resins, usually straight grained, and normally uniform in texture and workability because there is little difference between sapwood and heartwood and between spring and summer wood. In comparison with many other timber species it is a low-strength wood, but its toughness and strength properties are relatively high in proportion to its light weight.

Poplar holds nails and screws well, and its resistance to splitting by nails makes it a good box wood. It can be glued readily

except where tension wood (gelatinous fiber) is present. Because of its white color it can be easily stained, and it takes paint and varnish well. It is generally odorless, though a Spanish report states that the wood of *Populus alba* "supplies good building material" but is not "valued for packing because it imparts to the goods a disagreeable smell."

Poplar wood is soft (easily dented) ; it does not splinter and it is easily veneered without previous steaming. It is a poor fuelwood because of its low density and fast burning. Nevertheless, in localities where fuel is scarce there is an excellent market for branch wood, prunings, and fagots.

The sapwood is preferred to heartwood for many uses. For this reason there is often a better market for fast-growing wood than for slow-growing timber that has a high percentage of heartwood. There are exceptions: in France the author was informed that roadside trees make better matchwood, because of their slower and more uniform growth, than trees grown on alluvial bottom lands.

Utilization in Europe

The uses of poplar wood in Europe are manifold. Although log sizes required for different uses vary from country to country, and even from locality to locality within a country, the following specifications for minimum diameters—without bark, small end of the bolt or log—represent a fair average for all of Europe:

2.3 inches: Round poles for construction use.
2.75 inches: Pulpwood. Some mills take peeled wood as small as 1.5 inches.
6.0 inches: Wooden shoes.
6.0 to 10.0 inches: Box and building lumber. Specifications for saw logs are extremely variable. The smaller sizes are frequently marketable in southern Europe; the minimum diameter in northern Europe is seldom under 8 inches.
7.5 inches: Matchwood.
10.0 inches: Lowest grade veneer, for chip baskets, etc.
15.7 inches: Rotary veneer.
19.0 inches: Highest grade sliced veneer.

Log-length specifications are extremely diverse, depending on local custom and factory requirements. Bolts of many lengths up to 8 feet are specified for specialty and veneer use, but many factories buy poplar in tree lengths.

Specialty uses

Poplar wood has many specialty uses because of its white color, lack of odor and resins, workability, softness, light weight, relatively high strength in proportion to its weight, and resistance to splintering. It is used for artificial limbs and is extensively used for wooden shoes. Minor uses include turnery products and kitchenware such as ladles, wooden spoons, and bowls. It is also used for the production of excelsior.

Large quantities are used for boxes and crates of all kinds and for slack cooperage. It is particularly useful for containers because of its lightness, the relatively high strength in comparison

to its weight, and its nailing quality. In Germany it is preferred for crating large mirror glass. It is in demand for tubs, pails, and barrels to be used as food containers because of its lack of odor and resins. Since the wood does not splinter it has been used as a safety measure for trim in railway cars. Because of its light weight and freedom from splintering it is used for wagon construction, for the bottom of truck bodies, and for the manufacture of various types of handcarts and wheelbarrows.

Poplar is used in all countries for the manufacture of furniture, particularly for interior members. The Forest Research Institute in Spain has produced some excellent samples of molded furniture from poplar veneer.

Because of its softness and even texture, poplar is frequently used for drawing boards; and it is preferred for carving and toys. *P. alba* is used by at least one manufacturer in France for drafting instruments.

In recent years compressed-board products have been made from poplar. The compression of the wood raises the strength quality but also increases the density.

Veneers

Poplar is used in all countries for the production of both rotary and sliced veneer. It is veneered cold, without steaming or soaking, up to 6 months after cutting—and sometimes longer. Rotary veneer is used in the manufacture of matches (fig. 30), match boxes, fabricated plywood doors, plywood sheets for building purposes, cigar boxes, boxes for various packaging purposes, chip baskets, and woven baskets. It is used in Germany for storage-battery separators because of its freedom from chemical contaminants.

Some manufacturers of veneer baskets and boxes saw out short planks clear of knots to the width and length of the required veneer pieces. These blocks are then sliced on a guillotine-type machine that can cut through as much as 12 inches of poplar plank. The baskets or boxes are made immediately, without seasoning the veneer.

Sliced veneer is used to a considerable extent as a face veneer for furniture. Burly poplar, called Maser Pappel, commands a premium price for such use in Germany.

The presence of tension wood in poplar will make it unsuitable for veneer production. Tension wood causes warping and buckling of veneer; and it produces rough fuzzy surfaces when the wood is machined. Such surfaces are extremely difficult to work and are reported to require 60 percent more glue. The causes of tension wood are not definitely known but it is usually correlated with lean, eccentric growth, and possibly with the mechanical effect on the stemwood of swaying by wind. Other important defects that make the wood unsuitable for veneer use are insect and fungous damage, large knots, numerous small knots produced by epicormic branching, and, occasionally, spiral grain.

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FIGURE 30.—Poplar logs for matchwood, Saintines, France.

Lumber

The wood of the European black poplar has been used for centuries as round or sawed lumber for interior building construction where high strength is not required and where it is not subject to moisture. The Lombardy is preferred in the Mediterranean region of France for building construction because the wood is believed to be stronger than that of other poplars grown in the region. Round poles are used for rafters, stringers, and frequently for staging in the construction of buildings.

Poplar lumber must be carefully stacked and seasoned because it is subject to serious warping and twisting (fig. 31). Many mills saw the poplar logs into halves or into thick planks for seasoning, and resaw the seasoned lumber to the finished product. The lumber is stable after seasoning, and there is seldom warping after manufacture; but seasoned wood is somewhat more difficult to work than green wood.

Pulp

Poplar is used for both mechanical and chemical pulp, but in some localities the demand and higher prices for veneer and saw logs leaves only a small proportion of the supply available for pulpwood use. Practically all grades of paper, from writing paper and magazine stock to newsprint and wrappings, are made in Italy with a furnish containing poplar groundwood or chemical pulp. A mill in the Po Valley, visited by the author, was making

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FIGURE 31.—Members of the International Poplar Commission inspecting poplar lumber in the yard of a sawmill near Granada, Spain. All the lumber in this yard is poplar.

newsprint reported to be 50 percent unbleached poplar groundwood, 20 percent spruce groundwood, and 30 percent spruce sulfite; they also made a supercalendered sheet described as 70 percent bleached poplar groundwood and 30 percent spruce sulfite. A mill in southern Italy was using a furnish of 75 percent poplar groundwood and 25 percent coniferous chemical pulp.

Utilization in the United States

Our native poplars are utilized for the same purposes as the European poplars, with relatively few exceptions. Cottonwood lumber has been used in the upper Mississippi basin since pioneer days; and where it reaches its best development it has been an important veneer species for a long time. Records show that the excellent cottonwoods along the Hoosic River in northwestern Massachusetts and southwestern Vermont brought premium prices 100 years ago.

On the other hand, until very recently our native aspen was generally considered a weed tree, suitable only for limited pulpwood use. During the war years, this situation changed in the Lake States region. Since 1947 the Lake States Forest Experiment Station has published 22 reports by 9 cooperating agencies on the availability and supply, properties and uses, and management of aspen.

In recent years the use of poplar, with the exception of pulpwood in certain regions, has been increasing as rapidly as the sup-

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ply and log quality would permit. The most profitable future increase may be expected in the demand for high-quality logs for the veneer and lumber industries.

Utilization of poplar will surely keep pace with even the most optimistic predictable increase in the production of high-quality logs. Steady and reliable log markets will be available only where there is an assured supply of good poplar timber. Intensive management of native cottonwood and aspen can assure such supplies in some regions. But intensive culture of thoroughly tested hybrid clones will eventually provide the most profitable, constant, and uniformly high-quality timber supply.

Although hybrid-poplar culture in the United States is still in the experimental stage, European utilization provides complete assurance that properly selected and tested hybrids will meet, and possibly surpass, the use requirement of our native species.

Pulp and paper

All species of poplar are easily pulped by the standard chemical or mechanical methods, and they are also suitable for mechanical defiberizing processes. Poplar is used in high-grade papers (book, tissue, and specialities), and also for fiberboard, wallboard, and impregnated building board or felt.

The chemical pulp yield from poplar wood is lower, on a weight-per-cord basis, than the yield from the heavier hardwoods. During the past 25 years, most pulp mills in regions that have abundant native hardwood species have changed, in part or entirely, to the utilization of these heavier species. Poplar is still in demand in regions like the Lake States where there is a high concentration of paper and pulp industries. Increased utilization of the short-fibered woods for groundwood and chemigroundwood pulp may bring poplar into increasing competition with the heavier hardwoods.

Veneer

Among veneer woods, cottonwood ranked seventh on a national basis in 1944. As a core stock for doors, building panels, and furniture, poplar is competing successfully with other native species such as yellow-poplar (*Liriodendron tulipifera* L.). Large volumes of poplar veneer are used for food containers such as cheese boxes, egg cases, fruit and berry boxes, and soft drink and beer cases. The use of poplar for veneer is presently limited by the supply of veneer-quality logs.

Boxes and crating

The use of poplar lumber and veneer for shipping containers of all sorts was greatly expanded during the war, when its adaptability for such utilization was adequately tested. Since the war it has gained steadily in preference over other box woods for many uses.

Lumber

Poplar lumber is used locally in building construction for rafters, stringers, studding, sheathing, shiplap, flooring, and interior moldings and trim. Its use as lumber has been limited by spotty supply of logs of suitable size and quality, poor manufacture and seasoning by small mills, lack of standard grading rules, and relatively little effort to expand the market.

Furniture and specialty uses

Poplar is used for painted furniture, furniture shelving, backs, drawer ends and bottoms, and dust separators. Specialty uses in the United States include excelsior, turnery products, toys and novelties, and wagon-box boards.

Farm uses

Home-grown poplar has been used in the construction and repair of dwellings, barns, and other farm buildings. A Massachusetts apple grower obtained several years' supply of excellent apple-box lumber from a few large hybrid poplars originally planted as shade trees. Poplar wood is too susceptible to decay to be used for fence posts unless treated with a preservative; pressure-treated aspen posts in test plots were in good condition after more than 15 years. Creosoted aspen has also given good wear as bridge planking.

APPENDIX

Identification and Naming of Poplars

The genus *Populus* is divided into 5 generally accepted sections, only 3 of which are of importance in European poplar culture. Aigeiros poplars (Section *Aigeiros* Duby; spelled also *Aegirus*) include the cottonwoods and black poplars. Leuce poplars (Section *Populus;* known commonly as Section *Leuce* Duby [18]) are the white poplars and aspens. The use of Tacamahaca poplars, also called balsam poplars (Section *Tacamahaca* Spach) has been very limited.

Taxonomic studies of the European poplars were neither contemplated nor attempted in connection with these investigations. The native poplar species of Europe are reasonably well defined, but it will be very difficult to establish the validity of natural varieties of *Populus nigra* L. and *P. alba* L. because of the extensive natural hybridization and probable introgression within the sections to which these two species belong.

European poplar culture, with the exception of aspen in the Scandinavian countries, is based on the use of clones. Its economic importance stems primarily from the possibility of maintaining hybrid vigor and other superior qualities of a single individual through vegetative propagation. This exclusive use of clones is unique in the practice of timber and cellulose production.

Although the term clone is now in general use, it is still necessary to stress its significance as Stout [19] did in 1929:

> In considering the status of a clone it should be constantly held in mind that an entire clone, even though it comprises thousands of plants, is merely one seedling plant that has been multiplied by vegetative propagation. . . . the tendency has been to give clones a specific or a varietal rank that is not warranted, and to bestow on them scientific names that ignore the horticultural status of the clone.

In the same paper Stout also proposed that the word *ramet* (from the Latin *ramus*, meaning branch) be used for a member (an individual tree) of the clone. To indicate the original seedling plant from which the clone is derived he suggested that the word *ortet* (from the Latin *ortus*, meaning origin) may be used. These terms are used in this report.

In the poplar regions of Europe, particularly in France, Germany, and Italy, literally hundreds of clones have been planted. Unfortunately the extent and degree of this heterogeneity can

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[18] Under the International Code of Botanical Nomenclature (Art. 22. 1956), as amended in 1950, the section of a genus including the type species repeats the generic name without citation of an author. If *Populus alba* L. is taken as the type species of this genus, the section of white poplars and aspens should be called *Populus* section *Populus*. However, the common name Leuce poplars, long in international usage, can be retained for this section.

[19] Stout, A. B. *The clone in plant life.* N. Y. Bot. Gard. Jour. 30: 25–37. 1929.

never be accurately determined because closely related clones may be practically identical in their taxonomic characters. Differences in physiological characteristics often appear only under special conditions such as unusual climate, disease epidemics, or insect infestations. Growth rate of individual trees in the same planting can seldom be used as a distinguishing physiological characteristic because of the effect of local soil variability.

The International Poplar Commission apparently recognized the impossibility of distinguishing many closely related clones when it originally proposed to name the cultivated poplars with a binomial followed by a "forma" name. Later, at its 8th session in Madrid (1955) the Commission adopted, for naming the cultivated poplars, the International Code of Nomenclature for Cultivated Plants.[20] Under this code the "forma" is replaced by the category "cultivar" (abbreviated cv.) or the restrictive category "clone" (abbreviated cl.).

Since a cultivar name may include any number of clones that are taxonomically similar, the use of cultivar names will not solve the very practical problem of separating taxonomically similar poplar clones that are physiologically different. This can be accomplished only by the selection of single trees as ortets for vegetative propagation, and the distribution of all ramets from a single ortet under strictly controlled clone numbers or names. It is practically impossible to establish the clonal identity of taxonomically indistinguishable poplars without proof of their origin from the same ortet.

Thousands of ortets are being selected for clonal tests by European foresters, nurserymen, farmers, and landowners; and in most cases the selectors maintain the clonal identity of their ramets. Since the ortets are often plantation trees it is to be expected that within a locality, and even in different countries, genetically identical clones are being propagated and tested under different clonal designations. Such duplication is unavoidable but will not lead to serious difficulties in research or practice. Yet too large a minority of poplar selectors are still propagating mixtures of ramets from two or more ortets that are taxonomically indistinguishable. These mixtures may be given new names, or they may be included under an older cultivar name if they fit the general description. In either case this can lead only to further confusion in practice and research.

The International Poplar Commission, in its 1955 session, instructed the Committee on Nomenclature and Registration of Poplar Names to begin work on an International Register of cultivar names in accordance with the International Code of Nomenclature for Cultivated Plants. In 1957, at the 9th session in Paris, the Commission accepted the proposal that the following names, accompanied by the corresponding description card and under the numbers indicated below, be entered in the special register that

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[20] Stearn, William T., ed. *International code of nomenclature for cultivated plants.* 29 pp. Royal Horticultural Society, London. 1953.

will be opened at the Secretariat of the International Poplar Commission:

57/1—*Populus ×euramericana* 'serotina d'Exaerde'. Common name: Poplar "Bleu d'Exaerde".
57/2—*Populus ×euramericana* 'serotina de Selys'. Common name: de Selys poplar.
57/3—*Populus ×euramericana* 'serotina'. Common name: Swiss poplar.
57/4—*Populus ×euramericana* 'serotina de Champagne'.
57/5—*Populus ×euramericana* 'serotina du Poitou'. Common name: White Poitou Poplar.
57/6—*Populus deltoides* 'angulata de Chautagne'.
57/7—*Populus deltoides* 'carolin'. Common name: Carolin poplar.
57/8—*Populus deltoides* 'virginiana de Frignicourt'. Common name: Virginia poplar.
57/9—*Populus ×euramericana* 'robusta'.
57/10—*Populus ×euramericana* 'I–154'.
57/11—*Populus ×euramericana* 'I–214'.
57/12—*Populus ×euramericana* 'I–262'.
57/13—*Populus ×euramericana* 'I–455'.

Selection of poplars in the United States has already resulted in the description and naming of at least a dozen cultivars, and this number may be greatly increased within the next few years. To avoid confusion, such names and descriptions should conform to the revised International Code of Nomenclature for Cultivated Plants published in 1958.[21] Because the 1953 Code was prepared primarily for horticulture, a revision more applicable to cultivated plants in general was needed. The revision was made by an International Commission composed of horticulturists, agronomists, and foresters.

Poplar Names Used in This Report

Botanical names

The botanical names of the poplar species used in this report follow Little [22] for the United States and Rehder [23] for others.

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[21] International Commission for the Nomenclature of Cultivated Plants. *International code of nomenclature for cultivated plants.* 28 pp., rev. Utrecht. 1958.

[22] Little, Elbert L., Jr. *Check list of native and naturalized trees of the United States (including Alaska).* U. S. Dept. Agr., Agr. Handb. 41, 472 pp. 1953.

[23] Rehder, Alfred. *Manual of cultivated trees and shrubs hardy in North America.* Ed. 2. 996 pp. New York. 1954.

——— *Bibliography of cultivated trees and shrubs hardy in the cooler temperate regions of the northern hemisphere.* 825 pp. Jamaica Plain, Mass. 1949.

American and most European taxonomists accept the validity of *Populus* ×*canadensis* Moench (*P. deltoides* × *nigra*).[24] European poplar experts have objected to this name as being a source of confusion and the International Poplar Commission has officially accepted *Populus* ×*euramericana* (Dode) Guinier,[25] published in 1950,[26] as the collective name for hybrids of *P. deltoides* × *nigra*.

According to Rehder,[27] Moench's *Populus canadensis* is apparently the oldest name for the hybrid between *P. nigra* and *P. deltoides*, and his description, though meagre, is adequate.

G. Houtzagers,[28] commenting on the use of the name *Populus* ×*canadensis* Moench, was of the opinion that it is taxonomically and genetically incorrect to name all new forms of *P. deltoides* × *nigra*, or of their hybrids, as varieties of P. ×*canadensis* Moench, but agreed if "varietas" were changed to "forma" the name *P.* ×*canadensis* Moench forma *serotina*, forma *regenerata* etc. would be in accordance with the International Rules of Botanical Nomenclature. Nevertheless, he suggested that the name *P.* ×*canadensis* be rejected because it has been used erroneously by various authors.

Under the present International Code (Arts. H.1 and H.5) a collective Latin binomial includes the hybrids of all generations, including backcrosses. It is not genetically incorrect to use such a collective hybrid name, provided its collective significance is clearly understood. Although a name may be rejected if it is used in different senses and so has become a long-persistent source of error, rejection of the name *P.* ×*canadensis* Moench would require acceptance of the next oldest name, perhaps the name *P.* ×*serotina* Hartig.

The Netherlands taxonomist, B. K. Boom, has presented the soundest evidence for maintaining the name *P.* ×*canadensis* Moench.[29] In 1956, Boom visited the park and the Natural History Museum at Kassel to search for some of Moench's original material. He reported that the original trees are no longer in existence and that Moench's herbarium was destroyed during World War II. However, he did find an old xylothec with leaves and fruit, and sufficient documentation to state: "Therefore I am convinced that we may safely accept the contents of box 188 of Schildbach's

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[24] Moench, Konrad. *Verzeichnis ausländischer bäume und sträuche des lustschlosses weissenstein bei cassel.* 144 pp. [p. 81.] Frankfort and Leipsig. 1785.

[25] Report of the Standing Executive Committee on the application to the genus *Populus* of the rules laid down in the International Code of Nomenclature for Cultivated Plants. UN FAO, Internatl. Poplar Comn., 8th Sess. (Madrid), 13 pp. 1955. (Mimeog.)

[26] UN FAO Internatl. Poplar Comn. Rpt., 4th Sess., p. 16; Geneva, 1950.

[27] Rehder, Alfred. *New species, varieties, and combinations from the herbarium and the collections of the Arnold Arboretum.* Arnold Arboretum Jour. 4 (2): 111. 1923.

[28] Houtzagers, G. *Het geslacht Populus in verband met zijn beteekenis voor de houtteelt.* 266 pp. Wageningen, The Netherlands. 1937.

[29] Boom, B. K. *Populus canadensis Moench versus Populus euramericana Guinier.* Acta Bot. Neerlandica 6: 54–57. 1957.

xylothec as neotype of *P. canadensis* Moench. Which clone it presents is not absolutely certain, but the leafshape and the female character suggests that it may be cv. 'regenerata'."

Cultivar names

The poplar names used in this report conform to the International Code of Nomenclature for Cultivated Plants and accordingly have been placed in single quotation marks. For the sake of brevity, the cultivar names directly follow the generic name, as permitted by the code.

Table 7 lists the briefed cultivar names as they appear in this report, the full name in accordance with the International Code of Nomenclature for Cultivated Plants, and the names most commonly used in the poplar literature.

TABLE 7.—*Summary of poplar cultivar names used in this report*

ames used in this report	Full name in accordance with the International Code of Nomenclature for Cultivated Plants	Names most commonly used in the literature
Populus 'Allenstein'	*P.*×*canadensis* 'Allenstein'	Allenstein *P.*×*euramericana* 'Allenstein'
P. 'Angulata'	*P. deltoides* 'Angulata'	*P. deltoides angulata*
P. 'Angulata de Chautagne'	*P deltoides* 'Angulata de Chautagne'.	*P. deltoides* 'Angulata de Chautagne'
P.×*berolinensis* Dipp	*P.*×*berolinensis* Dipp. (=*P. laurifolia* × *nigra* 'Italica').	×*P. berolinensis*
P. 'Bietigheim'	*P.*×*canadensis* 'Bietigheim'	Bietigheim *P.*×*euramericana* 'Bietigheim'
P. 'Blanc de Garonne'	*P. nigra* 'Blanc de Garrone'	Blanc de Garonne
P. 'Blanquillo'	*P. nigra* 'Blanquillo'	Blanquillo Blanco
P. 'Bolleana'	*P. alba* 'Bolleana'	*P. alba bolleana*
P. 'Bordils'	*P. nigra* 'Bordils'	Bordils
P. 'Brabantica'	*P.*×*canadensis* 'Brabantica'	×*P. brabantica* *P.*×*euramericana* 'brabantica'
P.×*canadensis* Moench	*P.*×*canadensis* Moench (=*P. deltoides* × *nigra*)	×*P.canadensis* *P.* ×*euramericana* (Dode) Guinier
P.×*canescens* (Ait.) Sm	*P.*×*canescens* (Ait.) Sm. (=*P. alba* × *tremula*)	×*P.canescens*
P. 'Carolin'	*P.*×*deltoides* 'Carolin'	×*P. carolinensis* *P. deltoides* 'carolin'
P. 'Drömling'	*P.*×*canadensis* 'Drömling'	Dromling *P.*×*euramericana* 'Drömling'
P. 'Eckhof'	*P.*×*canadensis* 'Echof'	Eckhof *P.*×*euramericana* 'Eckhof'
P.'Eugenei'	*P.*×*canadensis* 'Eugenei'	×*P. eugenei* *P.*×*euramericana* 'eugenei'
P. 'Eugenei Feminine'	*P.*×*canadensis* 'Eugenei Feminine'	×*P.*eugenei feminine *P.*×*euramericana* 'eugenei feminine'
P. 'Eukalyptus'	*P.*×*canadensis* 'Eukalyptus'	Eukalyptus *P.*×*euramericana* 'Eukalyptus'
P. 'Flachslanden'	*P.*×*canadensis* 'Flachslanden'	Flachslanden *P.*×*euramericana* 'Flachslanden'
P. 'Gelrica'	*P.*×*canadensis* 'Gelrica'	×*P. gelrica* *P.*×*euramericana* 'gelrica'
P.×*generosa* Henry	*P.*×*Generosa* Henry (=*P. trichocarpa* × *angulata*)	×*P. generosa*

TABLE 7.—*Summary of poplar cultivar names used in this report*—Continued

Names used in this report	Full name in accordance with the International Code of Nomenclature for Cultivated Plants	Names most commonly used in the literature
P. 'Grandis'	*P.* ×*canadensis* 'Grandis'	Grandis *P.* ×*euramericana* 'Grandis'
P. 'Heidemij'	*P.* ×*canadensis* 'Heidemij'	*P. deltoides missouriensis* *P. deltoides* 'missouriensis' *P.* 'Heidemij'
P. 'I-28'	*P.* ×*canadensis* 'I-28'	I-28 *P.* ×*euramericana* 'I-28'
P. 'I-37'	*P.* ×*canadensis* 'I-37'	I-37 *P.* ×*euramericana* 'I-37'
P. 'I-65'	*P.* ×*canadensis* 'I-65'	I-65 *P.* ×*euramericana* 'I-65'
P. 'I-137'	*P.* ×*canadensis* 'I-137'	I-137 *P.* ×*euramericana* 'I-137'
P. 'I-154'	*P.* ×*canadensis* 'I-154'	I-154 *P.* ×*euramericana* 'I-154'
P. 'I-214'	*P.* ×*canadensis* 'I-214'	I-214 *P.* ×*euramericana* 'I-214'
P. 'I-262'	*P.* ×*canadensis* 'I-262'	I-262 *P.* ×*euramericana* 'I-262'
P. 'I-455'	*P.* ×*canadensis* 'I-455'	I-455 *P.* ×*euramericana* 'I-455'
P. 'I-477'	*P.* ×*canadensis* 'I-477'	I-477 *P.* ×*euramericana* 'I-477'
P. 'I-488'	*P.* ×*canadensis* 'I-488'	I-488 *P.* ×*euramericana* 'I-488'
P. 'I-Caroliniano Bianco de Cercenasco'	*P.* ×*canadensis* 'I-Caroliniano bianco de Cercenasco'	I-Caroliniano bianco de cercenasco *P.* ×*euramericana* 'I-Caroliniano bianco de cerenasco'
P. 'Isar'	*P.* ×*canadensis* 'Isar'	Isar *P.* ×*euramericana* 'Isar'
P. 'Italica'	*P. nigra* 'Italica'	*P. nigra italica* *P. nigra* 'italica'
P. 'Leipsig'	*P.* ×*canadensis* 'Leipsig'	Leipsig *P.* ×*euramericana* 'Leipsig'
P. 'Lloydii'	*P.* ×*canadensis* 'Lloydii'	×*P. lloydii* *P.* ×*euramericana* 'lloydii'
P. 'Löns'	*P.* ×*canadensis* 'Löns'	Löns *P.* ×*euramericana* 'Löns'
P. 'Mainou'	*P.* ×*canadensis* 'Mainou'	Mainou *P.* ×*euramericana* 'Mainou'
P. 'Manitobensis'	*P.* ×*canadensis* 'Manitobensis'	×*P. manitobensis* *P.* ×*euramericana* 'manitobensis'
P. 'Marilandica'	*P.* ×*canadensis* 'Marilandica'	×*P. marilandica* *P.* ×*euramericana* 'marilandica'
P. 'Monilifera'	*P. deltoides* 'Monilifera'	*P. deltoides monilifera* *P. monilifera*
P. 'Neupotz'	*P.* ×*canadensis* 'Neupotz'	Neupotz *P.* ×*euramericana* 'Neupotz'
P. 'Nigrito'	*P.* ×*canadensis* 'Nigrito'	Nigrito *P.* ×*euramericana* 'Nigrito'
P. 'Poncella'	*P. nigra* 'Poncella'	Poncella
P. 'Polla Carolina'	*P. deltoides* 'Polla Carolina'	Polla Carolina Carolina
P. 'Regenerata'	*P.* ×*canadensis* 'Regenerata'	×*P. regenerata* *P.* ×*euramericana* 'regenerata'
P. 'Regenerata Harff'	*P.* ×*canadensis* 'Regenerata Harff'	Harff poplar *P.* ×*euramericana* 'regenerata Harff'

TABLE 7.—*Summary of poplar cultivar names used in this report*—Continued

Names used in this report	Full name in accordance with the International Code of Nomenclature for Cultivated Plants	Names most commonly used in the literature
P. 'Regenerata d'Hautervive'	*P.* ×*canadensis* 'Regenerata d'Hautervive'	×*P. d'Hauterive* *P.* ×*euramericana* 'regenerata d'Hautervive'
P. 'Robusta'	*P.* ×*canadensis* 'Robusta'	×*P. robusta* *P.* ×*euramericana* 'robusta'
P. 'Robusta Bachelieri'	*P.* ×*canadensis* 'Robusta Bachelieri'	×*P. Bachelieri* *P.* ×*euramericana* 'Bachelieri'
P. 'Robusta Vernirubens'	*P.* ×*canadensis* 'Robusta Vernirubens'	×*P. vernirubens* *P.* ×*euramericana* 'robusta vernirubens'
P. 'Robusta Zeeland'	*P.* ×*canadensis* 'Robusta Zeeland'	×*P. robusta Zeeland* *P.* ×*euramericana* 'robusta Zeeland'
P. 'Serotina'	*P.* ×*canadensis* 'Serotina'	×*P. serotina* *P.* ×*euramericana* 'serotina'
P. 'Serotina de Champagne'	*P.* ×*canadensis* 'Serotina de Champagne'	×*P. serotina de champagne* *P.* ×*euramericana* 'serotina de Champagne'
P. 'Serotina d'Exaerde'	*P.* ×*canadensis* 'Serotina d'Exaerde'	*P.* ×*euramericana* 'Serotina d'Exaerde'
P. 'Serotina Erecta'	*P.* ×*canadensis* 'Serotina Erecta'	×*P. serotina erecta* *P.* ×*euramericana* 'serotina erecta'
P. 'Serotina Keppelse Groene'	*P.* ×*canadensis* 'Serotina Keppelse Groene'	*P.* ×*euramericana* 'serotina Keppelse Groene'
P. 'Serotina du Poitou'	*P.* ×*canadensis* 'Serotina du Poitou'	×*P. serotina de Poitau* *P.* ×*euramericana* 'serotina du Poitou'
P. 'Serotina de Selys'	*P.* ×*canadensis* 'Serotina de Selys'	*P.* ×*euramericana* 'Serotina de Selys'
P. 'Vert de Garonne'	*P. nigra* 'Vert de Garonne'	Vert de Garonne
P. 'Virginiana'	*P. deltoides* 'Virginiana'	*P. deltoides virginiana* ×*P. virginiana*
P. Virginiana Carolin'	*P. deltoides* 'Virginiana Carolin'	*P. deltoides* 'Virginiana Carolin' ×*P.* virginiana carolin
P. 'Virginiana de Firgnicourt'	*P. deltoides* 'Virginiana de Frignicourt'	*P. deltoides* 'Virginiana de Frignicourt'

Insect Names Used in This Report

American and European entomologists do not agree on the legitimate scientific names of all insects. The names used in this report are those officially accepted by the entomologists of the United States Department of Agriculture who are responsible for insect identification. The following tabulation lists the insects mentioned in this report under names that differ from those used in Europe or in the older American literature.

Names used in this report	Names used in Europe or in the older American literature
Aegeria apiformis (Cl.)	*Sesia apiformis* Cl.
Chaleoides aurata (Marsh.)	*Crepidodera aurata* Marsh.
Chaleoides helxines (L.)	*Crepidodera helxines* L.
Chrysomela populi L.	*Melasoma populi* L.
Chrysomela tremulae F.	*Melasoma tremulae* F.
Cryphalus asperatus (Gyll.)	*Cryphalus binodulus* Ratz.

Names used in this report	Names used in Europe or in the older American literature
Dicranura vinula (L.)	*Cerura vinula* L.
Gypsonoma acerina Dup.	*Semasia acerina* Dup.
Harmandia loewi (Rübs.)	*Diplosis tremulae* Wtg.
Phratora vulgatissima (L.)	*Phyllodecta vulgatissima* L.
Phratora vitellinae (L.)	*Phyllodecta vitellinae* L.
Phratora laticollis Suffr.	*Phyllodecta cavifrons* Thomas
Phytagromyza populi Kalt.	*Napomyza populi* Kalt.
Phytobia carbonaria (Zett.)	*Agromyza carbonaria* Zett.
Sciapteron tabaniformis Rott.	*Sesia tabaniforme* Rott.
Sternochetus lapathi (L.)	*Cryptorhynchus lapathi* L.

Description of Poplar Stands Listed in Table 2

Cases 1 to 3.—Vicinity of St. Oedenrode, The Netherlands. A rather wet site well drained by many deep ditches. Soil is a heavy fertile loam; pH tested 6.5 to 7.0. Ground covered by grass, weeds, and nettles. Case 2 is on a slightly higher site with somewhat more slope than case 3. Original spacing: Case 1, 23 by 28 feet; case 2, 23 feet square; case 3, 26 by 30 feet.

Case 4.—Near Neunen, The Netherlands. On deep sandy loam of excellent texture but probably low in fertility; pH 6.0. This land, originally in oak coppice, was cleared and used several years for crops before the poplars were planted. It has been in grass for many years. Thinned at 27 years. Original spacing: 13 by 30 feet.

Case 5.—Vicinity of Mons, Belgium. On deep alluvial silt loam with a high organic content. Summer water table about 2.5 feet. Often flooded in winter. Grass and poplar management. Thinned at 10 years. Original spacing: 15 feet square.

Case 6.—Near Mons, Belgium, on the same excellent silt loam as case 5. This site has been poorly drained for the last 10 years because of a change in drainage control. Grass and poplar management. Thinnings at 10, 11, and 17 years. Original spacing: 13 feet square.

Case 7.—Grammont, Belgium. A bottom-land site subject to only occasional overflow and well drained by ditches. The soil is a rather heavy silt loam, with grass and weed cover. At least one thinning. Original spacing: 11 feet, triangular.

Cases 8 and 9.—Schleswig-Holstein, Germany. Cases 8 and 9 represent two locations in the same stand on an excellent bottom-land site. Soil is well drained with a rather high water table. The poplars were planted in openings in a 20-year-old beech-oak stand. No information about the original spacing, stand density, or how the poplars were released. Forest ground cover.

Cases 10 to 15.—Along the river Erft in the vicinity of Grevenbroich, Gustorf, and Frimmersdorf, Germany. On excellent bottom land with considerable local variation in soil. These sandy loams to loamy sands are generally fertile but usually too wet in the spring for agriculture. Under grass and poplar management. Original spacing: Case 10, 23 feet square; case 11, 26 feet square; case 12, 23 by 26 feet; cases 13 and 14, each 16 by 23 feet; case 15, 23 by 26 feet.

Case 16.—Bottom-land site in the Ems lowlands near Glandorf, Germany, on deep, moist, organic sand with ground water at about 2 feet. Original spacing: 10 feet, triangular.

Case 17.—Near Warendorf, Germany. On deep humus-poor sand with ground water at 6.5 to 8.0 feet. Trees fertilized at the time of planting. Original spacing: 20 feet, triangular.

Cases 18 and 19.—On strongly loamy sand, so-called "Senkelboden," near Everwinkel, Germany. Ground water at about 2 feet. Case 18 includes inside trees only. Border trees averaged 14.0 inches d. b. h. and 79 feet in height. Original spacing: Case 18, 10 by 13 feet; case 19, 16 feet square.

Case 20.—Vicinity of Dingden, Germany. An excellent site that was formerly a pond. Light sandy soil, more than 3 feet deep, drained by numerous deep ditches to a larger ditch with constantly flowing water. An underplanting of Norway spruce at wide spacing has produced a good profit from Christmas tree sales. Original spacing: 16 feet square.

Cases 21 and 22.—Lignite district west of Cologne, Germany. Plantations on strip-mine banks, with filler trees of white alder, locust, and maple. The trees were fertilized at time of planting. The fill is a mixture of sand and gravel with some clay particles but without organic matter. Roots of poplars planted on new mine banks, loose fill, are reported to penetrate 33 feet deep within 5 years after planting. Original spacing: Case 21, 8 feet square; case 22, 14 feet square.

Case 23.—Lignite district west of Cologne, Germany, on a strip-mine bank; gravelly sand rich in mineral nutrients, with some clay but no organic material. White alder planted 5 by 5 feet as filler trees; cut at 10 years. Poplars thinned twice. Original spacing: 10 feet square.

Cases 24 and 25.—Lignite district near Hermulheim and Frechen, Germany, respectively. Plantations on strip-mine banks; loamy sand, somewhat gravelly without organic matter; pH reported to be 7.0 to 8.0. Planted the year the banks were completed. No fertilizer was used. White alder, spaced 5 by 5 feet as filler trees; cut at 12 years; one thinning of poplars. Case 24A is on a low terrace with only 6.5 to 10 feet of fill over the original heavier soils. Case 24B is on a higher terrace that has 16.5 to 23 feet of fill. Original spacing: Cases 24A and B, and 25, each 10 feet square.

Case 26.—Vicinity of Wavelinghoven, Germany. On excellent bottom land originally too wet for agriculture because of flooding in the spring. Much of it has been drained through river improvement. Grass under the poplars. Original spacing: 26 by 39 feet.

Case 27.—This stand near Grevenbroich, Germany, had been cut because of heavy shell damage during the war. An excellent bottom-land site. Original spacing: 16 by 23 feet.

Cases 28 and 29.—Erft River bottom land, Harff, Germany. On excellent sandy silt loam and loess-loam soils high in lime. Poplars interplanted among widely spaced bottom-land hardwoods. Original spacing not known but poplars are said to have "suffered

from the pressure of an old stand now cut." Measurements represent the best trees. Forest ground cover.

Case 30.—On upland site near Harff, Germany. Loess-loam soil, water table very deep, annual rainfall 21.7 inches. Heavy losses from rabbits and war damage. Original spacing: 20 by 27 feet.

Case 31.—Bad Rothenfelde, Germany. On deep organic diluvial sand with weak "bänderton" at about 3 feet. Ground water at approximately 2.5 feet. Two thinnings. Original spacing: 16 feet square.

Cases 32 to 35.—Rhine valley near Karlsruhe, Germany. Approximately 15 inches of clay loam varying to sandy and silty clay over coarse sand and gravel. The moderately heavy to heavy texture of these soils is not favorable for growth of poplars. The pH at 15 to 25 inches is reported to be approximately 7.0. Cases 32 and 33 are sample plots in the same stand, originally interplanted with 2 rows of ash and 1 row of alder between the poplar rows. First thinning was at 41 years, at least one thinning between 41st and 57th year. Case 34 interplanted with ash and alder. Forest ground cover in all cases. Original spacing: Cases 32 and 33, 20 by 39 feet each; cases 34 and 35, unknown.

Case 36.—Rhine Valley near Rappenwört, Baden, Germany. On fertile reclaimed bottom-land soil. Mixed hardwood understory; forest ground cover. Original spacing unknown.

Case 37.—Rhine Valley near Karlsruhe, Germany. On deep, fertile, silt loam to silty clay loam, subject to overflow; pH 6.0+. Filler trees of ash and alder. Forest ground cover. Original spacing: 26 by 49 feet.

Case 38.—Rhine Valley near Neuburgweier, Baden, Germany. On deep, fertile, well-drained silt loam to silty clay loam; pH 6.5–7.0. Interplanted with *Acer pseudoplatanus*. Forest ground cover. Original spacing: 26 by 49 feet.

Cases 39 to 42.—Bottom land at the juncture of the Danube and Isar Rivers, Bavaria, Germany. Very fertile soils, 6.5 feet or more of silt loam subject to annual overflow; pH reported 5.5 to 6.0. Early culture of the older stands uncertain. In recent years the land has been in grass; the younger stands were established in grass. Original spacing: Cases 39-41, each 11 feet square; case 42, unknown.

Cases 43 and 44.—Marne Valley near Perthois, France. On excellent bottom-land soils subject to frequent overflow. Soil is highly fertile, deep, silty clay loam; pH 6.0+. Said to be one of the best soils in this area. *P.* 'Virginiana' (case 42) and 'Robusta' (case 43) on adjacent areas. Grass and poplar culture. Original spacing: each 23 feet square.

Case 45.—On bottom land in the Voire Valley, France. Rather heavy alluvial soil. Hay and pasture under the poplars. Original spacing: 23 feet square.

Case 46.—Voire Valley, France. Alluvial bottom land with about 12 to 20 inches of gravel underlain by a compact clay subsoil. Grass and poplar culture. Original spacing: 23 feet square.

Case 47.—Voire Valley, France. Bottom land with about 2

feet of light loamy sand over gravel on a clay subsoil. Organic content high in upper 10 to 12 inches of the soil. Site, originally in oak coppice, was cropped before it was planted to poplars. Original spacing: 26 by 30 feet.

Case 48.—Near Wassy (Blaise Valley), France. On a very deep, alluvial, marly, clay loam subject to overflow. Original spacing unknown.

Case 49.—Blaise Valley, France. Bottom land with medium-heavy alluvial soil over clay. Grass under the poplars. Original spacing: 23 feet square.

Case 50.—Rhone Valley near Rochemaure, France. On excellent deep silt loam over coarse sand on a terrace well above the river and not subject to overflow; pH above 6.0. Grass ground cover. It is reported that in dry summers the water table could drop to 13 feet. The last 10 years have been dry; 1947 and 1949 reported to have been particularly dry years—70 days of drought in the summer of 1949. Original spacing: 13 feet square.

Case 51.—Near La Palud, France, in the Rhone Valley. On low wet land adjacent to the river side of the protection dike. Soil is a deep, fertile alluvium subject to overflow. Early culture uncertain. Original spacing: 10 feet square.

Case 52.—Rhone Valley near Bourg-St.-Andeol, France. On fertile bottom land subject to overflow. Well-drained silt loam; pH above 6.0. Grass and herbaceous ground cover. Original spacing: 10 by 16 feet.

Case 53.—Garonne Valley near Toulouse, France. On bottom-land terrace with light sandy soil, low in fertility, and subject to overflow only at very high flood stage. Summer water table 3 to 6 feet; in dry years considerably deeper. After supporting a previous stand of poplar, the land was used for crops for about 10 years before it was replanted to poplar. Present stand intercropped 4 years after planting, followed by hay and later grazing. Original spacing: 20 feet square.

Case 54.—Reclaimed land near Yvonaud, Switzerland. This land was lake bottom and swamp land until reclaimed through control of the river Aare. A very fertile sandy loam to silt loam with a high organic content. Early culture not known, apparently interplanted with other bottom-land species including alder. Forest ground cover. Original spacing unknown.

Cases 55 to 59.—Po Valley, Casale Monferrato, Italy. On bottom lands subject to overflow. Early culture with crops 3 or 4 years, followed by grass and weeds. Soils are variable even in the same plantations. Cases 56 and 57 are in the same plantation rows where there is a soil gradient from poor loamy sand (case 56) to a fertile silty loam with a good ground cover of nettles (case 57). Original spacing: Cases 55-58, each 11 by 33 feet; case 59, 13 feet, triangular, in double rows 39 feet apart.

Cases 60 and 61.—Po Valley near Isolone, Italy. Excellent fertile alluvial soil subject to overflow. Case 60 is on land previously used for poplar, cleared and cropped for 1 year before replanting to poplar, then intercropped and irrigated during the first 3 years after the poplars were planted. Case 61 was inter-

cropped for 4 years after planting, then cultivated for an additional 3 years. Original spacing: Case 60, 11 by 30 feet; case 61, 16 feet square.

Case 62.—Po Valley near Piacenza, Italy. On excellent well-drained bottom land subject to overflow. Mixture of about 60 clones selected at Casale Monferrato from open-pollinated seed from selected mother trees. Intercropped during the first 3 or 4 years; now in grass and weeds. Original spacing: 11 by 33 feet.

Case 63.—Albalate del Arzobispo, Spain. One-year-old trees planted on excellent fertile bottom land subject to overflow and previously used for garden crops. Interplanted with *Pinus halepensis* and *P. canariensis.* Cultivated until plantation was closed. Original spacing: 13 feet square.

Case 64.—Toradera River Valley near Hostalrich, Spain. Plantation established with unrooted sets. On well-drained loamy sand to sandy loam with a low summer water table. Plantation is still irrigated when necessary with water pumped from the river. Intercropped in the early years followed by light stand of grass cut for fodder. Original spacing: 16 feet square.

Description of Row Plantings Listed in Table 5

Case 65.—Vicinity of Sutphen, The Netherlands, on sandy loam between a paved road and a 3- to 4-foot-deep highway ditch. No information on water table; probably not lower than 4 to 5 feet in summer.

Cases 66A–C.—Near Meppen, Germany, on well-drained sandy soil around the border of a pasture that was fertilized at irregular intervals. Water table not lower than 3 feet. The poplars were not fertilized at the time of planting.

Cases 67 to 70.—Nos. 67 and 68 are single rows, 69 and 70 are double rows, in the vicinity of Warendorf, Germany. They are all on deep sand deficient in organic matter. The planting stock, 2-year-old trees, was fertilized with 11 pounds of Thomasmehl mixed with the soil in each planting hole. Ground water on sites 67 and 68 was at 6.5 to 8 feet, on sites 69 and 70 at 9.5 to 10 feet.

Case 71.—Trees along an old filled road near Everswinkel, Germany. The soil is a loamy sand with ground water at about 2 feet.

Case 72.—A double row in Holtwick, Germany, on deep sandy loam of good texture and fertility. Considerably better soil than case 73.

Case 73.—Holtwick, Germany. Deep loamy sand; ground water at 2 to 2.5 feet. Soil rated as "medium sour"; the poplars have been limed.

Cases 74 to 76.—Vicinity of Glandorf, Germany. On deep moist sand with considerable organic content and ground water at about 2 feet. Rows 75 and 76 established with unrooted sets. Case 75 is a row along a brook bank and is underplanted with alder.

Case 77.—Frimmersdorf, Germany, on excellent fertile bottom land subject to overflow. Grass and poplar culture.

Case 78.—Near Baden-Baden, Germany, on a fertile bottom-land soil of medium texture.

Case 79.—Vicinity of Karlsruhe, Germany. Fertile overflow land with 2 to 2.5 feet of loam or sandy loam over coarse sand and gravel. Excellent poplar site.

Case 80.—Very fertile bottom land subject to frequent overflow at the juncture of the Danube and Isar Rivers, Bavaria, Germany. Same site as cases 39 to 42.

Cases 81 and 82.—Seine Valley, St. Hilaire, France. Fertile silty clay loam with high organic content; pH 6.0 to 7.0; subject to occasional overflow. Depth of water table varies from 1 to 2.5 feet, never below 3 feet in dry summers.

Cases 83 and 84.—Vicinity of Saint-Urbain, France. Row plantings along the Marne canal on excellent bottom-land soil. Grass under the trees.

Case 85.—Voire Valley, Puellemontier, France. Four rows along a low embankment across good bottom land. The rows are 20 feet apart.

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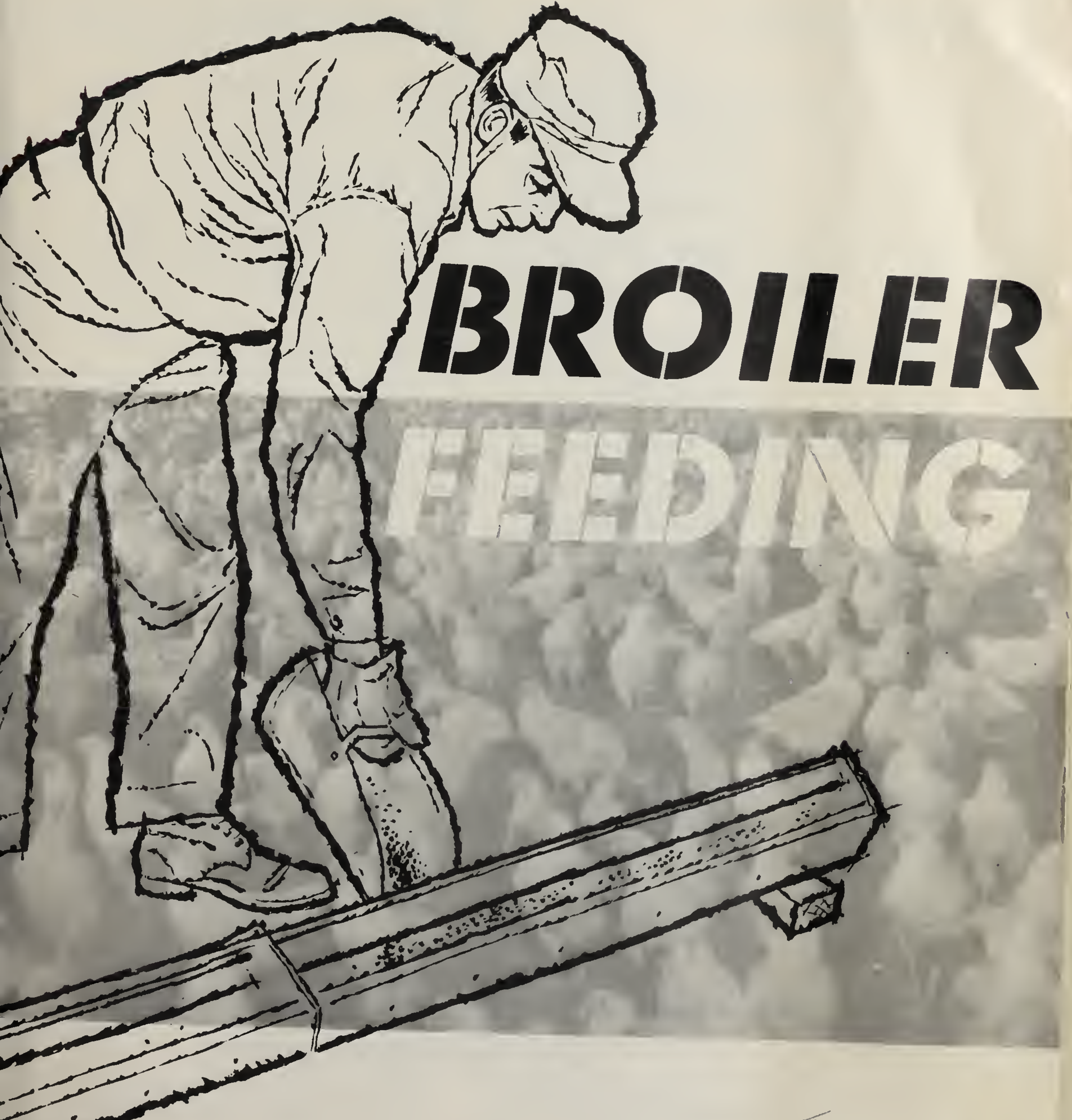
BROILER FEEDING



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BROILER FEEDING

Broiler raising is one of agriculture's most effi-
ent enterprises. Rations supplied broilers
ıould produce a 3-pound bird with good feather-
g and pigmentation in 8 to 10 weeks at the least
ssible cost. An efficient conversion job can be
ne only if adequate amounts of the required
aterials are supplied in the proper balance.

UTRIENT REQUIREMENTS

Broiler diets are made up of many nutrients.
search has determined the minimum amounts
d, in some cases, maximum amounts necessary
good growth. It has been found that other
tary materials also are required if the bird is
reach a desired weight in the shortest length
time and at the lowest feed cost. Still other
terials are included in the ration to improve
rket quality. Each of these nutrients and
led materials is discussed in the following
tions.

OTEIN

rotein is the principal material used by the
l to build tissue. Starter diets that usually
fed the first 6 to 8 weeks should contain at
t 22 to 24 percent of protein. The costs of
tein ingredients may make it desirable to re-
e this range to 17 to 19 percent for finishing
he broilers, because the bird's protein require-
ts gradually decline as it grows older. Re-
ng the protein level too soon or too much
be false economy. Too great a reduction in
ein content reduces growth rate and feed
iency to a point where the saving in feed cost
ore than canceled out.

he total quantity of protein in the diet is im-
ant, but equally important is the quantity of
of certain amino acids found in protein.
amino acids are the parts that, fitted to-
er, form the various kinds of plant and ani-
proteins. Eleven of these parts are consid-
essential—ten because they cannot be synthesized, or manufactured, by the bird, and an eleventh, glycine, because it cannot be synthesized by the bird in adequate amounts. Two additional amino acids, cystine and tyrosine, can be substituted in part for two that the chick cannot synthesize, methionine and phenylalanine. Requirements of the eleven essential amino acids are listed in table 1. Most efficient growth occurs when the essential ones are supplied in balanced amounts.

Animal protein sources, such as fishmeal, meat scrap, and dried milk, contain adequate quantities of the essential amino acids. The most commonly used vegetable proteins, soybean oil meal, and cottonseed meal, are relatively low in certain of the essential amino acids. When either of these two meals is used as the sole protein concentrate, the soybean oil meal diet may be deficient in methionine and the cottonseed meal diet is likely to be inadequate in lysine. Methionine is used as a dietary supplement. Lysine may be available commercially for this purpose. Cottonseed meal is used in broiler diets in combination with soybean oil meal, with animal proteins, or with both.

Processing conditions affect the amino acid availability and content of all protein materials. One of the most important of these conditions is heat exposure—both maximum temperatures and duration of heat exposure of the meal during processing. Meals that have not been heated excessively during processing usually are the most desirable protein concentrates.

CARBOHYDRATE AND FAT

Carbohydrate and fat serve primarily as fuel in the body although protein may also be used for this purpose. Excess amounts may be stored as body fat.

Carbohydrate is listed on feed analysis tags under two headings, nitrogen-free extract and crude fiber. Nitrogen-free extract is made up of starches and sugars that are readily utilized. Crude fiber is a woody material not readily

utilized by chickens and should not constitute more than 4 percent of a broiler diet. Principal sources of carbohydrate are the grains and their byproducts.

Fat is a concentrated source of energy that supplies approximately 2.25 times as much energy as the same weight of carbohydrate. A certain amount of fat is present in most feedstuffs used in poultry rations. Research has shown that adding fat as a separate ingredient improves feed efficiency and, in some cases, increases the rate of growth. In addition, it makes feeds less dusty and enhances their appearance, texture, and palatability. Equipment for mixing liquid fat with dry ingredients has been developed. Chemicals called antioxidants are added to the fat to reduce the likelihood of rancidity.

The amount of fat added to commercial broiler diets may range from 1 to 8 percent. In general, the proper amount to add is that which will result in the production of a pound of chicken for the least possible cost. This in turn will depend on improvement in growth and feed efficiency resulting from adding the fat, the price of fat, and the price of other dietary ingredients. Therefore, there is no specific recommended level that will be suitable for all conditions.

TABLE 1.—*Essential amino acid requirements for starting chicks*[1]

Amino acid	Requirement[2]
	Percent of ration
Arginine	1.20
Lysine	.90
Histidine	.15
Methionine[3]	.80
Tryptophan	.20
Glycine[4]	1.00
Phenylalanine[5]	1.60
Leucine	1.40
Isoleucine	.60
Threonine	.60
Valine	.80

[1] From *Nutrient Requirements for Poultry. A Report of the Committee on Animal Nutrition.* National Research Council Publication 301.
[2] Based on a diet containing 20 percent of protein.
[3] Cystine can be substituted for part of the methionine on the following basis: Cystine 0.35 percent and methionine 0.45 percent of the ration.
[4] The chick can synthesize glycine but the synthesis does not proceed at a rate sufficient for maximum growth.
[5] Tyrosine can be substituted for part of the phenylalanine on the following basis: Tyrosine 0.7 percent and phenylalanine 0.9 percent of the ration.

TABLE 2.—*Vitamin requirements for starting chicks*

Vitamin	Minimum requirement[1]	Recommended allowance[2]
	Per pound of feed	*Per pound of feed*
A[3]	1,200 USP[4]	4,400 USP.
D[5]	90 ICU[6]	400 ICU.
E[7]	7–11 IU[8]	
K[7]	0.180 mg	
B-complex:		
Thiamine	0.800 mg	0.9 mg.
Riboflavin	1.300 mg	2.3 mg.
Niacin	12.000 mg	24.0 mg.
Pantothenic acid	4.200 mg	6.4 mg.
Pyridoxine	1.300 mg	1.5 mg.
Biotin	0.040 mg	0.5 mg.
Choline[7]	600.000 mg	670.0 mg.
Folacin	0.250 mg	0.3 mg.
Vitamin B_{12}[7]	0.004 mg	

[1] From *Nutrient Requirements for Poultry. A Report of the Committee on Animal Nutrition.* National Research Council Publication 301. Amounts listed contain no margin of safety and refer to units of pure vitamin. Amount of vitamin supplements included in a ration will depend on the potency of the product used.
[2] It is felt that high-efficiency diets increase the requirement for several nutrients, particularly vitamins and protein.
[3] May be vitamin A or vitamin A precursor.
[4] USP (United States Pharmacopoeia) is the equivalent of 0.344 microgram of vitamin A acetate.
[5] May be vitamin D_3 from fish oil or irradiated anima sterol.
[6] ICU (International Chick Unit) is the equivalent o 0.025 microgram of pure vitamin D_3, a form of the vitamin used by poultry.
[7] Tentative—exact requirement not known.
[8] IU (International Unit) is the equivalent of 1 milligran of dl-alpha-tocopherol acetate.

The majority of broiler diets probably contai 2 to 4 percent of added fat, which brings thei total fat content up to 6 to 8 percent. It is em phasized that, from a nutritional standpoint, fa is added only for the purpose of increasing th energy content of the diet. The amount of f added is important only for its contribution to tl total energy content of the diet, which is tl sum of the energy derived from fat, carbohydrat and protein.

The productive energy probably varies from 9 to 1,100 Calories[1] per pound in most broiler diet For optimum feed efficiency the number of Calori in a diet should be related to the protein conte In research to discover the proper relationship b tween Calorie and protein content, no fixed rat has been established. Good results have been c

[1] As used in this publication, "Calorie" equals 1 la calorie or 1,000 small calories.

ned with starting diets containing 42 to 45 Cal-
ies for each percent of protein and with finishing
ets containing 50 Calories for each percent of
otein.

'TAMINS

Vitamins are substances found in most natural
ds in extremely small amounts. Those consid-
d necessary for growth and maintenance of
lth are: A, D, E, K, and the B complex, which
ludes thiamine, riboflavin, niacin, pantothenic
d, pyridoxine, biotin, choline, folacin, and vita-
B_{12}. Requirements per pound of feed for these
amins are listed in table 2. The requirements of
K, and B_{12} are tentative, but research has shown
t under most conditions these minimums are
irable. Recommended allowances are consider-
y above the minimum requirements listed; the
pose is to provide a safety margin to offset var-
on in vitamin content of feedstuffs and possible
min loss due to deterioration.

amin A

'itamin A is important for proper nerve func-
and helps to prevent infections of the eye
the respiratory tract. Deficiency retards
wth and impairs the bird's health.

ietary requirements may be met by adding
oils, vitamin A concentrates, or plant mate-
s that the animal can convert into vitamin A.

ABLE 3.—*Mineral requirements for starting chicks* [1]

Mineral	Minimum requirement	
	Percent of ration	*Milligrams per pound of feed*
um	1.0	
phorus [2]	.6	
m	[3] .5	
anese		25.0
e		.5
		9.0
er [4]		.9

om *Nutrient Requirements for Poultry. A Report of*
ommittee on Animal Nutrition. National Research
cil Publication 301.

least 75 percent of the nutrition requirement for
horus should be of the inorganic type. All of the
horus of nonplant feed ingredients is considered to be
nic and approximately 30 percent of the phosphorus
nt products may also be considered inorganic.

is figure represents sodium chloride added as such
t in marine or fermentation products of high sodium
de content.

ntative—exact requirement not known.

TABLE 4.—*Approximate composition of all-mash broiler rations by ingredient classes*

Class of ingredient	Percent of ration
Carbohydrate ingredients [1]	55–60
Vegetable-protein ingredients [2]	20–25
Animal-protein ingredients [3]	5–10
Vitamin-rich ingredients [4]	4–8
Stabilized fats [5]	0–8
Mineral carriers [6]	3–4
Miscellaneous ingredients [7]	

[1] Grains and grain byproducts: Corn, wheat, barley, oats, millet, shorts, middlings, red dog, hominy feed, etc.

[2] Soybean, cottonseed, and peanut meals.

[3] Fishmeal, fish solubles, meat scrap, liver meal, dried milk, feather meal, etc.

[4] Commercial vitamin supplements, alfalfa, dried whey, dried yeast, distillers' solubles, fermentation solubles, etc.

[5] Grease, tallow, etc.

[6] Limestone flour, oyster shell flour, dicalcium phosphate, steamed bonemeal, defluorinated superphosphate, defluorinated rock phosphate, iodized salt, manganese sulphate, etc.

[7] Trace amounts of these ingredients may be added. Many are present in commercial rations, but some may not be necessary under all conditions. The group includes antibiotics, coccidiostats, arsenicals, surfactants, hormones, antioxidants, and xanthophyll.

Alfalfa meal and yellow corn contain vitamin A precursors, or substances that form vitamin A. However, the amounts of the vitamin precursor in alfalfa meal and yellow corn usually are not considered in making up a formula. Sufficient amounts of vitamin A concentrates usually are added to meet the bird's full requirement.

Vitamin D

Vitamin D is essential for normal utilization of calcium and phosphorus in bone building. When it is not supplied in sufficient quantity, young chickens grow slowly and develop soft bones regardless of the amount of calcium and phosphorus in the diet.

The chicken synthesizes vitamin D when exposed to sunlight, but concentrates containing the vitamin (fish oils and irradiated animal sterols) are added to rations because broilers seldom are raised in sunlight. These concentrates should be premixed with ground corn, bran, middlings, alfalfa, or soybean meal, because intimate contact with minerals brings about rapid destruction of vitamin D activity.

Vitamin E

Adequate amounts of vitamin E prevent exudative diathesis and a condition known as "crazy

chick" disease, or encephalomalacia. Exudative diathesis is characterized by a swelling of fatty tissues just beneath the skin. Birds affected by crazy chick disease are unable to coordinate movements of their legs, wings, and neck.

Vitamin E is found in cereal grains, alfalfa meal, and liver meal. It usually is added to the diet in wheat germ oil or as alphatocopherol acetate. Like vitamin A, the destruction of vitamin E is accelerated by contact with rancid fat.

Vitamin K

Vitamin K is required to preserve the clotting power of the blood. A deficiency is marked by hemorrhages, which may occur in any part of the body. The vitamin can be obtained from meat scrap, fish products, or alfalfa meal.

Vitamin B Complex

RIBOFLAVIN.—Riboflavin is essential for normal growth and prevents curled-toe paralysis. It is widely distributed in feedstuffs and also is available as a synthetic compound. Among the best natural sources are dried milk products and brewers' yeast. Riboflavin is reasonably stable under ordinary storage conditions.

CHOLINE.—Choline is one of the vitamins required for normal growth and is a factor in the prevention of perosis, or slipped tendon. The chick's requirement is met, in most diets, by the addition of choline supplement.

VITAMIN B_{12}.—Vitamin B_{12} is added to diets that contain no animal proteins, because vegetable proteins are deficient in this vitamin. Vitamin B_{12} is available as a commercial supplement.

OTHER REQUIRED VITAMINS.—Thiamine, niacin, pantothenic acid, pyridoxine, biotin, and folacin are present in adequate quantities in the feedstuffs normally included in diets. It is not considered necessary to add them separately, although extra quantities of niacin and pantothenic acid commonly are included in broiler diets

TABLE 5.—

Ingredient	Protein	Crude fat [7]	Fiber	Minerals: Calcium	Minerals: Phosphorus: Inorganic [1]	Minerals: Phosphorus: Total
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Alfalfa meal, dehydrated	17.8	2.8	24.2	1.07	0.06	0.20
Barley, excluding Pacific Coast	12.7	1.9	5.4	.09	.12	.40
Barley, Pacific Coast	9.0	2.0	6.0	.60	------	.30
Brewers' dried yeast	44.6	1.1	2.7	.13	.43	1.43
Buttermilk, dried	32.0	5.8	.4	1.34	.94	.9[illegible]
Corn, yellow dent	8.9	3.9	2.0	.02	.09	.3[illegible]
Corn gluten meal	42.9	2.3	4.0	.16	.12	.4[illegible]
Cottonseed meal (expeller)	41.4	5.8	10.7	.18	.34	1.1[illegible]
Cottonseed meal (solvent) [5]	41.6	1.6	11.0	.15	------	1.1[illegible]
Distillers' dried grains with solubles (corn)	27.2	9.3	9.0	.17	.20	.6[illegible]
Distillers' dried solubles	26.9	9.1	3.8	.35	.40	1.3[illegible]
Fat, stabilized	------	100.0	------	------	------	------
Feathers, hydrolyzed poultry [3]	85.0	3.0	1.0	------	------	------
Fishmeal, menhaden	61.0	7.7	.7	5.49	2.81	2.8[illegible]
Fish solubles, condensed	31.4	6.5	.6	.61	.70	[illegible]
Linseed oilmeal (solvent)	35.1	1.7	8.9	.40	.25	[illegible]
Milo maize (sorghum)	11.3	2.9	2.2	.03	.09	[illegible]
Meat and bone scraps	50.6	9.5	2.2	10.57	5.07	5.[illegible]
Meat scraps [5]	53.4	9.9	2.4	7.94	4.03	4.[illegible]
Oats, except Pacific Coast	12.0	4.6	11.0	.09	.12	[illegible]
Oats, Pacific Coast	9.0	4.5	12.0	.10	------	[illegible]
Oats (feeding), rolled	15.0	6.3	2.0	.07	.12	[illegible]
Peanut meal (solvent) [5]	47.4	1.2	13.1	.20	------	[illegible]
Poultry byproduct meal [3]	56.0	14.0	2.0	3.50	1.70	1.[illegible]
Skimmilk, dried	33.5	.9	.2	1.26	1.03	1[illegible]
Soybean meal, solvent dehulled [5]	50.9	.8	2.8	.26	------	[illegible]
Soybean meal, solvent	45.8	.9	5.8	.32	.20	[illegible]
Tankage, digester [5]	59.8	8.1	1.9	5.94	3.17	3.[illegible]
Wheat, hard	15.2	1.8	2.6	.05	.12	[illegible]
Wheat bran	16.0	4.1	9.9	.14	.35	1.[illegible]
Wheat, standard middlings	17.2	4.6	7.6	.15	.27	[illegible]
Wheat germ oil	------	------	------	------	------	------
Whey, dried	13.1	.5	.3	.90	.80	[illegible]
Bonemeal, steamed	12.1	3.2	1.7	28.98	13.59	13.[illegible]
Calcium carbonate	0	0	0	36.59	0	0
Dicalcium phosphate	0	0	0	27.00	19.07	19[illegible]
Defluorinated rock phosphate	0	0	0	34.00	14.50	14[illegible]

[1] Poultry are better able to assimilate inorganic phosphorus than other types. At least 75 percent of the nutritive requirement for phosphorus should be of the inorganic type.

[2] Carotene values were obtained from NRC Publications 301 and 449 [illegible] the exception of alfalfa meal. The value for alfalfa meal was obtained [illegible] *1957 Feedstuffs Analysis* table.

ecause of the possibility that the addition is eneficial.

'inerals

Minerals have a number of functions in the rd's body. Some serve as structural materials r bones and tissue, while others are necessary r the production of enzymes and hormones. ılcium, phosphorus, sodium, manganese, iodine, ıgnesium, potassium, sulfur, and trace minerals ch as iron, copper, molybdenum, selenium, and ıc all must be included in the bird's diet. Defi-e requirements of the first five minerals and tative requirements of iron and copper have en established and are given in table 3. The ers, with the possible exception of molybde-m, are believed to be furnished in sufficient ounts by the grains and feedstuffs used in iler rations and do not have to be added as t of a mineral supplement.

Calcium and Phosphorus.—Calcium and phosphorus are bone-building materials that should be supplied in the required amounts and in the proper ratio. Both excesses and deficiencies should be avoided, because they interfere with growth and bone development.

The principal sources of calcium for broiler feeds are oyster-shell flour and high-calcium limestone. Available phosphorus is furnished in small quantities by vegetable-protein concentrates. Phosphoric acid is rich in phosphorus and seems to have commercial possibilities as a source of this mineral. Both calcium and phosphorus are supplied in liberal quantities by meat and fishmeals, bonemeal, and defluorinated calcium phosphates. Naturally occurring calcium-phosphate rock should not be fed, because usually it contains toxic amounts of fluorine.

Sodium.—Sodium usually is added to broiler rations in the form of salt (sodium chloride).

dstuffs analysis

Vitamins						Amino acids								
ɔo-vin	Niacin	Panto-thenic acid	Choline	A	E	Methi-onine	Cystine	Methi-onine plus cystine	Arginine	Lysine	Trypto-phan	Glycine	Produc-tive energy	Metabo-lizable energy
lli-ms r nd	*Milli-grams per pound*	*Milli-grams per pound*	*Milli-grams per pound*	*USP units per pound* [2]	*Milli-grams per pound*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Calories per pound*	*Calories per pound* [4]
7.3	8.7	12.3	400	100,000	[3] 85.00	0.32	0.34	0.66	0.80	0.90	0.23	-----	[4] 217	348
.8	24.1	3.7	500	0	0	.12	.20	.32	.50	.30	.13	-----	[4] 813	1,255
.5	20.0	3.0	400	-----	-----	.19	.15	.34	.40	.22	.10	-----	800	-----
5.9	203.4	49.9	1,766	0	0	.70	.50	1.20	2.20	3.00	.50	[3] 1.7	572	-----
4.1	3.9	13.7	822	0	0	.70	.30	1.00	1.10	2.40	.50	.2	[4] 786	1,247
.5	9.8	2.6	200	2,215.8	[3] 1.70	.14	.15	.29	.40	.30	.08	.4	[4] 1,105	1,535
.7	22.7	4.7	150	12,328.4	0	1.00	.60	1.60	1.40	.80	.20	2.1	[4] 821	1,095
2.4	15.4	4.7	1,262	10	11.48	.50	1.00	1.50	3.30	1.60	.50	[3] 2.4	[4] 800	1,159
2.1	20.7	8.1	1,301	0	4.96	.60	[6] .86	1.46	[6] 3.50	1.60	.50	2.3	[3] 560	-----
3.9	30.4	5.0	1,123	2,832.2	0	.50	.30	.80	.90	.70	.10	[3] .5	891	-----
7.7	52.4	9.5	2,190	499.8	[3] 7.00	.60	.60	1.20	1.00	.90	.20	[3] 1.1	[4] 1,020	1,395
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	[4] 2,878	-----
.8	8.0	3.5	400	-----	-----	.52	2.30	2.82	5.60	1.50	.57	5.9	800	-----
2.2	25.4	4.1	1,663	0	[3] 9.50	1.80	1.00	2.80	4.00	5.30	.60	4.0	[4] 941	1,230
.6	76.7	16.1	1,831	999.6	0	1.00	1.70	2.70	2.40	2.70	.80	2.3	[3] 440	-----
.3	13.7	6.5	557	0	0	.50	.60	1.10	2.80	1.30	.50	1.8	[4] 507	692
.4	13.1	5.0	250	0	0	.16	.20	.36	.30	.30	.09	[3] .4	[4] 1,099	1,528
.0	21.7	1.7	993	0	0	.70	.60	1.30	4.00	3.50	.20	2.0	[4] 874	1,152
.4	25.8	2.2	887	0	0	.80	.60	1.40	3.70	3.80	.30	2.2	[4] 949	1,249
.4	8.2	6.8	450	0	0	.13	.22	.35	.60	.40	.14	-----	[4] 810	1,133
-----	-----	-----	-----	-----	-----	.19	.17	.36	.50	.30	.10	-----	800	-----
.6	4.5	6.6	505	0	0	.24	.27	.51	.96	.61	.21	-----	[4] 1,162	1,612
.0	[3] 77.5	[3] 24.0	[3] 800	-----	-----	.40	-----	-----	5.90	2.30	.50	2.5	-----	-----
.8	18.0	4.0	2,720	-----	-----	1.00	1.00	2.00	2.76	3.70	.41	2.9	880	-----
.1	5.2	15.3	647	0	4.15	.80	.50	1.30	1.20	2.80	.40	.2	[4] 765	1,232
.4	9.8	-----	1,255	0	0	[3] .87	[3] .68	[3] 1.55	[3] 3.10	[3] 3.00	[3] .58	2.7	[4] 790	1,142
.5	12.2	6.6	1,247	0	0	.62	.66	1.28	3.20	2.90	.60	[3] 2.4	[4] 761	1,103
.1	17.8	1.1	986	0	0	.80	-----	-----	3.60	4.00	.70	-----	[4] 814	1,198
.5	24.1	6.3	450	0	0	.21	.24	.45	.50	.40	.16	-----	[4] 897	1,381
.4	95.1	13.2	491	0	4.49	.10	.30	.40	1.00	.60	.30	[3] .9	[4] 494	759
.9	44.8	9.0	488	0	9.50	.20	.20	.40	.90	.70	.20	[3] .4	[4] 694	1,043
-----	-----	-----	-----	-----	60.30	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	5.1	22.4	914	0	0	.15	.31	.46	.20	.80	.10	[3] .7	[4] 786	1,242
4	1.1	1.9	0	0	0	0	0	0	0	0	0	0	300	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0

m *1957 Feedstuffs Analysis* table.
m *Energy Values of Feedstuffs for Poultry.* Titus (1955).
m NRC Publication 449, June 1956.

[6] From NRC Publication 301, January 1954.
[7] Also called ether extract and includes all ether-soluble materials.

Manganese.—Manganese is present in nearly all ingredients of poultry feeds but not in sufficient quantity to insure an adequate supply. Dietary requirements may be met by adding manganese sulfate tetrahydrate. Lack of this mineral is a cause of perosis, or slipped tendon, in chicks.

Iodine.—The iodine content of feedstuffs is variable. Dietary requirements may be met by adding commercial iodized salt to poultry rations. An iodine deficiency leads to goiter formation, an enlargement of the thyroid gland of the neck.

Iron and Copper.—A deficiency of iron or copper results in nutritional anemia, but rarely occurs in practical diets. The grains and vegetable proteins used in broiler rations contain adequate amounts of these minerals and adding them separately is not considered necessary.

Miscellaneous Materials

Unidentified Growth Factors.—Certain unidentified factors are known to be important in animal nutrition. Three of these are well recognized and are called the "whey," "fish," and "alfalfa" factors.

The whey factor is thought to be present in distillers' solubles, distillers' molasses solubles, brewers' yeast, butyl fermentation solubles, and dried whey.

The fish factor is thought to be present in fishmeal, fish solubles, crab meal, meat byproducts, liver preparations, and certain fermentation products.

The alfalfa factor is thought to be present in dehydrated alfalfa leaf meal, grass juice concentrate, and dried brewers' yeast.

Antibiotics and Coccidiostats.—Antibiotics are added to rations either to stimulate growth or in connection with disease in the flock. The most commonly used ones are penicillin, chlortetracycline, oxytetracycline, and bacitracin. The addition of 4 to 5 grams of penicillin or 8 to 10 grams of the other antibiotics to a ton of feed usually results in lower flock mortality, more rapid growth, and greater feed efficiency. Addition of certain antibiotics at 100 to 250 grams per ton appears to be of value in reducing mortality and restoring birds to a healthy condition during outbreaks of some diseases. Most commercial broiler rations contain antibiotics at the lower level.

Coccidiostats are drugs added to rations to prevent or control the intestinal disease coccidiosis. Low levels of these drugs, included in a ration, enable birds to build up natural immunity. Higher levels help to control acute attacks of coccidiosis, but control generally is achieved more quickly by the addition of water-soluble coccidiostats to the drinking water.

A number of coccidiostats are in use, including sulfaquinoxaline, sulfamethazine, nitrophenide, and nitrofurazone. They should be used only at dosages recommended by the drug manufacturer since higher concentrations may be toxic.

Arsenicals.—Another group of compounds that are used as growth stimulants is the arsenicals. Although toxic at higher levels, small amounts have effects similar to the antibiotics. There is experimental evidence that an arsenical, plus an antibiotic in some cases, provides a growth response greater than either alone. There also is some evidence that arsenicals may improve pigmentation. Because of these two possibilities, most commercial broiler diets contain an arsenical.

The two commonly accepted arsenicals are arsonic acid (3-nitro, 4 hydroxyphenylarsonic acid), and arsanilic acid (para-amino-hydroxyphenylarsonic acid). Arsonic acid usually is used at 45 grams per ton and arsanilic acid at 90 grams per ton.

Surfactants.—Surfactants, also known as detergents, may stimulate growth. Few commercial broiler feeds contain surfactants, because there is little evidence that they provide growth stimulation beyond that provided by antibiotics.

Hormones.—Hormones are gland secretions that regulate body functions. Estrogen, the female sex hormone, causes increased fat deposition under the skin of the bird and results in higher carcass quality. Synthetic chemical compounds have been discovered that have the same effect as this natural hormone. The best known of these compounds is diethylstilbestrol, which came into use as a pellet and a paste for implantation in the neck of the bird. Another compound, dienestrol diacetate, has been mixed with feed for the same purpose. Broiler rations that contain this compound are available. Feed manufacturers are required to comply with regulations of the United States Food and Drug Administration and the State feed control officials before marketing broiler rations that contain dienestrol diacetate.

Antioxidants.—Antioxidants are chemical preservatives included in feeds to lessen the loss of

TABLE 6.—*All-mash broiler diets*

Ingredient	Diet number: Starting diets 1	2	3	4	5	6	Finishing diets 7	8
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
nd yellow corn [1]	59.40	53.94	59.34	55.49	59.54	57.94	64.62	66.61
nd wheat [2]	------	------	------	5.00	5.00	------	------	------
al fat [3]	------	4.00	------	4.00	------	4.00	1.00	------
ieal (60 percent)	6.00	5.00	5.00	5.00	5.00	------	5.00	5.00
scraps	------	------	------	1.00	1.00	------	------	------
ry byproduct meal	5.00	------	2.50	------	------	7.50	2.50	2.50
ers, hydrolyzed poultry	------	------	------	------	------	6.00	------	------
gluten meal	4.00	2.50	2.50	3.00	3.00	1.25	------	------
an meal, solvent [4]	18.00	25.50	22.00	10.00	10.00	------	18.00	16.50
an meal, solvent dehulled	------	------	------	------	------	16.00	------	------
nseed meal, solvent	------	------	------	8.00	8.00	------	------	------
whey	------	2.00	1.50	2.00	2.00	------	2.00	1.50
meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
distillers' solubles	2.50	1.50	1.00	------	------	1.50	1.00	2.00
m carbonate	1.25	.75	1.35	1.50	1.50	1.00	1.00	1.00
rinated rock phosphate	------	------	------	1.50	1.50	------	------	------
ium phosphate	.60	------	------	------	------	1.50	------	------
ieal, steamed	------	1.50	1.50	------	------	------	1.50	1.50
odized	.30	.30	.30	.40	.40	.30	.30	.30
nese sulfate (65 percent grade) [5]	.05	.05	.05	.05	.05	.05	.05	.05
in A supplement (4,000 USP units per gram) [5]	.05	.05	.05	.05	.05	.05	.05	.05
in D_3 supplement (1,500 ICU per gram) [5]	.06	.06	.06	.06	.06	.06	.06	.06
in B_{12} supplement (12 milligrams per pound) [5]	.05	.05	.05	.05	.05	.05	.05	.05
vin supplement (227 milligrams per pound) [5]	.50	.50	.50	.50	.50	.50	.50	.50
e supplement (25 percent grade) [5 6]	.10	.10	.10	.15	.10	.10	.10	.10
ethionine (feed grade) [5]	.04	.10	.10	.15	.15	.10	.17	.18
otic supplement (10 grams per pound) [5]	.05	.05	.05	.05	.05	.05	.05	.05
c acid (10 percent) [5 7]	.05	.05	.05	.05	.05	.05	.05	.05
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Grams per ton	*Grams per ton*	*Grams per ton*	*Grams per ton*	*Grams per ton*	*Grams per ton*	*Grams per ton*	*Grams per ton*
ostat [8]	+	+	+	+	+	+	+	+
	25	25	25	25	25	25	25	25
n pantothenate	5	5	5	5	5	5	5	5
n E [5]	5	5	5	5	5	5	5	5
n K	1	1	1	1	1	1	1	1
	Calculated analysis							
protein, percent	22.7	23.9	21.7	21.5	21.8	23.9	19.3	19.0
tive energy, calories per pound	956	1,008	939	892	925	1,026	980	968
protein ratio [9]	42.0	42.1	43.3	41.4	42.4	42.9	50.0	50.9
at, percent	4.0	6.9	3.5	7.10	3.26	7.9	4.6	3.7
iber, percent	3.1	3.3	3.2	3.4	3.5	2.4	2.9	2.9
n, percent	1.24	1.14	1.43	1.53	1.53	1.13	1.29	1.29
orus, total, percent	.72	.73	.75	.77	.79	.72	.74	.75
orus, inorganic, percent	.47	.47	.51	.58	.59	.51	.50	.50
n A, USP units per pound	4,717	4,410	4,530	4,506	4,596	4.345	4,339	4,383
n D_3, ICU per pound	409	409	409	409	409	409	409	409
vin, milligrams per pound	2.44	2.29	2.36	2.22	2.24	2.33	2.3	2.3
milligrams per pound	25.3	23.8	24.1	24.5	24.9	22.8	23.5	24.0
enic acid, milligrams per pound	6.3	6.7	6.6	6.6	6.7	5.0	6.4	6.4
, milligrams per pound	760	685	705	655	607	700	667	666
ine, percent	.45	.47	.47	.49	.49	.45	.5	.51
, percent	.36	.34	.34	.32	.32	.43	.31	.29
ine+cystine, percent	.81	.81	.81	.81	.81	.88	.81	.80
e, percent	1.29	1.31	1.28	1.15	1.16	1.32	1.13	1.10
percent	1.28	1.24	1.23	.97	.98	1.06	1.12	1.09
han, percent	.23	.24	.23	.20	.20	.22	.21	.20
, percent	1.17	1.11	1.11	.95	.96	1.28	.99	.97

maize may be substituted for corn if the fat and vitamin A deficien-
naize are compensated for. Barley may be substituted for corn if
luctive energy and vitamin A deficiencies of barley are compensated
nthophyll should be added for pigmentation.
or barley may be substituted for ground wheat if the formula is
for the differences in productive energy and vitamin content.
ld be stabilized with an antioxidant.
ssypolized cottonseed meal (meal containing 0.04 percent or less of
ypol) may replace up to 50 percent of soybean meal in broiler diets.

[5] May be supplied in the form of a supplement or as a pure product providing the amounts used are adjusted to meet the bird's requirement for the pure product.
[6] Contains 25 percent choline chloride.
[7] Contains 10 percent 3-nitro, 4 hydroxyphenylarsonic acid.
[8] Feed at level recommended by manufacturer.
[9] Figures represent the number of Calories per pound of feed for each 1 percent of protein.

luble vitamins (A, D, E, and K) and to
l the rancidity of added fats. The two most
ionly used antioxidants for poultry feeds are
(butylated hydroxyanisole) and BHT
lated hydroxytoluene). Either or both may
ded to poultry rations in line with limitations set by the United States Food and Drug Administration and State feed control officials.

XANTHOPHYLL.—Xanthophyll is the pigment that imparts yellow color to the skin and shanks of broilers. Yellow corn, corn gluten meal, and alfalfa meal are good sources of the pigment. If

TABLE 7.—*Sample worksheet showing*

Ingredient	Proportion of total diet		Productive energy, Calories per pound [2]	Protein [2]	Crude fat [2]	Fiber [2]	Vitamins				
							A	D	E	K	Riboflavin
	Percent	*Pounds per ton*	*Calories*	*Pounds per ton*	*Pounds per ton*	*Pounds per ton*	*USP [4] per ton*	*ICU [5] per ton*	*Grams per ton*	*Grams per ton*	*Milligrams per ton*
Yellow corn	59.40	1,188	1,312,740	105.73	46.33	23.76	2,632,370				594
Fishmeal (60 percent)	6.00	120	112,920	73.20	9.24	.84					264
Poultry byproducts meal	5.00	100	88,000	56.00	14.00	2.00					480
Corn gluten meal	4.00	80	65,680	34.32	1.84	3.20	986,272				56
Soybean meal, solvent	18.00	360	273,600	168.88	3.24	20.88					540
Alfalfa meal	2.00	40	8,680	7.12	1.12	9.68	4,000,000				292
Dried distillers' solubles	2.50	50	51,000	13.45	4.55	1.90					385
Calcium carbonate	1.25	25									
Dicalcium phosphate	.60	12									
Salt, iodized	.30	6									
Manganese sulfate (65 percent)	.05	1									
Vitamin A supplement (4,000 USP units per gram).	.05	1					1,816,000				
Vitamin D_3 supplement (1,500 ICU per gram).	.06	1.2						817,200			
Vitamin B_{12} supplement (12 milligrams per pound).	.05	1									
Riboflavin supplement (227 milligrams per pound).	.50	10									2,270
Choline CL (25 percent)	.10	2									
DL-methionine	.04	.8									
Antibiotic supplement (10 grams per pound).	.05	1									
Arsonic acid (10 percent)	.05	1									
Niacin											
Pantothenic acid											
Vitamin E									5		
Vitamin K										1	
Total per ton	100.00	2,000.0	1,912,620	454.90	80.32	62.26	9,434,642	817,200	5	1	4,881
Total per 100 pounds [6]			95,631	22.75	4.02	3.11	471,732	40,875	.25		244
Total per pound [7]			956				4,717	409	[8] .0025		2.4
Recommended allowance				22.24			4,400	400			2.3

[1] Diet analyzed is all-mash starting diet No. 1, table 6.
[2] Nutrient and energy content of each ingredient is calculated by multiplying the pounds used by the average composition figures given in table 5. That is, 1,188 pounds of corn (column 3) 8.9 percent protein (table 5) = 105.73 pounds of protein (column 5).

[3] Poultry are better able to assimilate inorganic phosphorus than oth types. At least 75 percent of the nutritive requirement for phospho should be of the inorganic type.
[4] USP (United States Pharmacopoeia) is the equivalent of 0.344 mic gram of vitamin A acetate.

the feedstuffs do not give the skin and shank a sufficiently deep color, additional xanthophyll can be added to the feed separately. Healthy birds generally show better pigmentation on any diet. For this reason, many ingredients may appear to have an effect on pigmentation (see Arsenicals, p. 8).

FORMULATION AND PREPARATION

Diet formulation refers to the selection of a particular ingredient combination that meets specific requirements. Preparation refers to the actual mixing of the ingredients chosen and the processing of the mixture to obtain a desired texture or form.

FORMULATION

In the formulation of a broiler ration, there are two steps: (1) Specific ingredients are chosen, and (2) amounts of each ingredient are calculated.

One of the principal considerations in choosing ingredients is their nutrient content. Most feed ingredients provide more than one of the requir nutrients, but certain ones are rich in a particul nutrient. On this basis they can be divided in seven broad classes: Carbohydrates, vegetab proteins, animal proteins, vitamin-rich ingred ents, stabilized fats, mineral carriers, and miscellaneous group that includes ingredie added in trace amounts. These seven classes a listed in table 4, with a percentage range to sh the approximate composition of all-mash ratio.

Choice of ingredients within a class depe largely on availability and price. In vari parts of the country and in different seasons the year, certain ingredients are available in qu tity. Because plentiful ingredients usually lower in price than scarce ones, the feed mi should choose the ingredients that can be co bined to provide the maximum nutritive valu the lowest possible cost. The resulting rat may not be the lowest priced mixture, but sho be one that meets nutritive requirements, ma possible rapid growth, low mortality, a qual carcass, and, at the same time, produces bre

lculation of nutrient content of a proposed diet [1]

Vitamins—Continued			Minerals				Miscellaneous materials		Amino acids					
Niacin	Panto-thenic acid	Choline	Calcium [2]	Phosphorus [2]		Mangan-ese	Anti-biotic	Arsen-ical	Methi-onine [2]	Cystine [2]	Argin-ine [2]	Lysine [2]	Tryp-tophan [2]	Gly-cinc [2]
				Inor-ganic [3]	Total									
illigrams er ton	Milligrams per ton	Milligrams per ton	Pounds per ton	Pounds per ton	Pounds per ton	Grams per ton	Grams per ton	Grams per ton	Percent of diet	Percent of diet	Percent of diet	Percent of diet	Percent of diet	Percent of diet
1,642	3,088	237,600	0.238	1.069	3.564	-----	-----	-----	0.083	0.89	0.238	0.178	0.048	0.238
3,048	492	199,560	6.588	3.370	3.370	-----	-----	-----	.108	.060	.240	.318	.036	.240
1,800	400	272,000	3.500	1.700	1.700	-----	-----	-----	.050	.050	.138	.185	.021	.145
1,816	376	12,000	.128	.096	.320	-----	-----	-----	.040	.024	.056	.032	.008	.084
4,392	2,376	448,920	1.152	.720	2.412	-----	-----	-----	.112	.119	.576	.522	.108	.432
348	492	16,000	.680	.024	.080	-----	-----	-----	.006	.007	.016	.018	.005	-----
2,620	475	109,500	.175	.200	.685	-----	-----	-----	.015	.015	.025	.023	.005	.028
-----	-----	-----	9.147	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	3.240	2.280	2.280	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	72.6	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	227,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	.04	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	10	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	45	-----	-----	-----	-----	-----	-----
,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	5,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
666	12,699	1,522,580	24.848	9.459	14.411	72.6	10	45	.454	.364	1.289	1.276	.231	1.167
533	635	76,129	1.242	.472	.73	3.63	-----	-----	.454	.364	1.289	1.276	.231	1.167
25.33	6.35	761.3	-----	-----	-----	[9].0363	-----	-----	.454	.364	1.289	1.276	.231	1.167
24.00	6.40	670.0	1.000	.45	.60	25.00	-----	-----	.450	.350	1.200	.900	.20	1.000

U (International Chick Units) are the equivalent of 0.025 microgram
e vitamin D_3, a form of the vitamin used by poultry.
viding total per ton by 20 (20 hundredweight=1 ton) gives the energy
utrient content per hundredweight. When this figure is in pounds,
e same as the percentage of the mixture. Figures on this line may be
ed against the nutritive requirements in the text and in tables 1 and 3.

[7] Dividing totals per ton by 2,000 gives energy and nutrient content per pound. Figures on this line may be checked against nutritive requirements in the text and in tables 1, 2, and 3.

[8] 0.025 grams=10,000 I U.

[9] 0.0363 grams=36.3 milligrams.

t at the lowest possible cost per pound. To
luce such a ration, consideration also should
given to palatability and quality of the in-
lients. Palatability is important since broil-
must consume large amounts of feed to make
d gains, and ingredient quality is important
neeting nutritional requirements.

he amount of each ingredient that goes into
formula depends on its nutritive content.
average composition of the most commonly
. broiler-feed ingredients is given in table 5;
ples of an ingredient may contain more or
of a specific substance than is listed.

ne information in table 5 enables the feed
er to choose ingredients and ingredient
unts for formulating various broiler diets.
e is no "best" diet. A number of combina-
s can be devised that will provide an efficient,
omical ration.

ECIMEN DIETS

ght specimen all-mash diets are given in table
Six of these are rations that may be fed

from starting time to market. Two are finishing diets that may be fed to the birds after the seventh week. Ingredient contents of the diets differ somewhat; one may be more desirable than the others in a particular part of the country, because of ingredient availability. All of the diets meet the nutritive requirements of broilers and will give a good rate of growth and feed efficiency under proper conditions, assuming average quality of all ingredients.

Broiler finishing diets are lower in protein and vitamin content, because the requirements for these nutrients decline as the birds grow older. Many broiler growers prefer to feed the starting ration the entire period, but finishing rations normally are lower in price than starting rations.

A method of checking a feed formula to be sure that it meets nutritive requirements is illustrated in table 7. This table may be used to calculate the nutritive content of any feed formula. The ingredients to be included are listed in column 1, and the percentage of each ingredient is listed

in column 2. Column 3 can then be filled in by calculating the pounds of each ingredient that would be included in a ton mixture.

The nutrient content of each ingredient then is calculated by multiplying the pounds used by the average composition figures given in table 5, and filling in the results under the proper headings in table 7.

NOTE.—In the diet analyzed in table 7, corn represents 59.4 percent of the diet, and 59.4 percent of 2,000 is 1,188, the number of pounds of corn used in this diet to mix a 2,000-pound batch. In this diet 1,188 pounds of corn (column 3) × 8.9 percent of protein (table 5) = 105.73 pounds of protein, which is entered in column 5.

When the table is filled in with the figures for a particular feed formula, the columns are totaled; this gives the nutritive content of a ton of feed. These totals then can be divided by 20 to obtain the nutrient content per hundredweight. When this figure is in pounds, it is the same as the percentage of the mixture. Figures on this line then may be checked against nutritive requirements in the text and in tables 1 and 3.

Dividing the total by 2,000 gives the nutritive content per pound of feed, and these figures can be used to check the requirements of those nutrients and materials required in very small amounts (tables 1, 2, and 3).

MIXING

Mixing is an important step in the preparation of an efficient economical ration. A baby chick eats about a thimbleful of feed a day. That thimbleful must meet all of the bird's nutritional requirements. Because only trace amounts of some ingredients are included in a ton of feed, a thorough mixing job is necessary if each thimbleful is to contain the nutrients in the proper proportions.

PROCESSING

After the feed is mixed, it may be processed further to obtain a desired form or texture.

Pellets probably are the most common form of processed feed. They usually are fed on top of the mash in hope of increasing feed intake and rate of growth. Pellets sometimes are fed as the entire ration, but the practice frequently results in cannibalism, particularly when the birds are confined.

Granules are another form of processed feed that is offered broiler raisers. They commonly are manufactured by breaking up pelleted feed into small particles, but a similar coarse-textured feed can be produced by using coarsely ground ingredients in the mixture. Birds seem to prefer a coarse feed to a fine, powdery mash. They tend to consume more and grow faster.

The extra processing necessary to produce pellets or granules makes them higher in price than coarsely ground mash.

FEED EVALUATION

Complete evaluation of feed formulas cannot be done on paper. Worksheets may show that a particular mixture meets nutritional requirement and is the lowest priced of those compared. Bu no method of calculating the amount of a partic ular feed that will be required to produce a poun of meat has been devised.

The most desirable feed or feed formula can b chosen by comparing the results of properly ru feeding tests. Feeds being tested should be fe simultaneously to separate flocks of the sam breeding and sex. All flocks should be sold at th same time, and careful records should be main tained throughout the feeding period.

Records should include figures for total fee consumed, total feed cost, total pounds of me sold, and total dollars received for each floc With these figures, the broiler raiser can compa the feeds tested, in three ways:

1. *Pounds of feed required to produce a pou of meat* can be determined by dividing the poun of meat sold into pounds of feed fed, for ea flock.

2. *Feed cost of a pound of meat* can be deter mined by dividing pounds of meat sold into to feed cost, for each flock.

3. *Income over feed cost* can be determined subtracting feed cost from dollars received, each flock.

The results of these calculations will enable the feeder to make a comparison of different feeds and assist him in deciding which feed or feed formula is best suited to his purpose.

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BOUND SEPARATELY

Insecticides from Plants

A REVIEW OF THE LITERATURE, 1941-1953

by Martin Jacobson
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INSECTICIDES FROM PLANTS

A Review of the Literature, 1941-1953

By Martin Jacobson, Entomology Research Division, Agricultural Research Service

In 1945 the former Bureau of Entomology and Plant Quarantine issued as E-661, "Plants of Possible Insecticidal Value, a Review of the Literature up to 1941," by N. E. McIndoo. Since that time much more information has been obtained regarding these plants, and many others have been tested or used as insecticides, repellents, or attractants. This review has therefore been extended to include the literature from 1941 through 1953, as well as a few references that were omitted from the previous publication. Because of the desirability of making the compilation as near complete as possible for a given period, the review does not extend beyond 1953; the lag is accounted for by the fact that references to much of the foreign literature are based on summaries appearing in abstracting journals, and these summaries sometimes appear several years after completion of the original work.

The plants are grouped by families, a total of 3,111 species being represented. No attempt has been made to include the large volume of material on the plant insecticides pyrethrum, rotenone, and nicotine, which are already well known and widely used.

We are indebted to S. F. Blake and F. J. Hermann, of the Crops Research Division, for supplying the botanical authorities and checking the order, family, genus, and species names of the plants. Authority names could not be located for those few plants lacking such names in this review.

AGARICACEAE

AMANITA MUSCARIA (Fr.) S. F. Gray. Fly agaric.

This plant is used as a fly poison in the Philippine Islands.--Quisumbing (179.).

The powdered plant was nontoxic to the Hawaiian beet webworm, melonworm, southern armyworm, cross-striped cabbageworm, and European corn borer. Combined petroleum ether and ethyl ether extractives were slightly toxic to codling moth larvae but not to house flies; combined chloroform and ethanol extractives of the extracted residue were nontoxic to these insects.--Bottger and Jacobson (36).

An aqueous extract of the fungus body was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected when immersed in the extract. A chloroform extract was toxic to black carpet beetles and Aedes mosquito larvae, but not to German cockroaches, milkweed bugs, webbing clothes moth larvae, and Anopheles mosquito larvae. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

AMANITA PANTHERINA (Fr.) Quélet.

An acetone extract of the whole plant was toxic to Culex pipiens larvae. The activity could be traced to the basic water-insoluble part of the extract.--Yamaguchi and coworkers (232).

LEPIOTA PROCERA (Fr.) S. F. Gray.

An acetone extract of the whole plant was toxic to Culex pipiens larvae.--Yamaguchi and coworkers (232).

CHARACEAE

CHARA sp.

An aqueous extract of the stems was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches immersed in the extract were not affected.--Heal and coworkers (93).

EQUISETACEAE

EQUISETUM ARVENSE L. Horsetail rush.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

The powdered plant was nontoxic to Mexican bean beetle larvae.-- Hansberry and Clausen (86).

Aqueous extracts of the fresh and dry whole plant were very toxic to American cockroaches when injected into the bloodstream.--Heal and coworkers (93).

EQUISETUM BOGOTENSE H. B. K.

An aqueous extract of the whole plant was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

EQUISETUM HYEMALE var. CALIFORNICUM Wilde.

An aqueous extract of the stems was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

EQUISETUM ROBUSTUM A. Br.

An aqueous extract of the stems was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

FUCACEAE

FUCUS VESICULOSUS L. Bladder wrack.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (89).

GIGARTINACEAE

CHONDRUS CRISPUS (L.) Stackh. Irish moss.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

HYPOCREACEAE

CLAVICEPS PURPUREA (Fr.) Tul.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

ISOETACEAE

ISOETES RIPARIA var. CANADENSIS Engelm. Synonym: I. dodgei A. A. Eaton.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LECANORACEAE

LECANORA RUBINA Ach.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A petroleum ether extract and a chloroform extract of the aqueous extractive were both toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. The chloroform extract was also toxic to Aedes mosquito larvae.--Heal and coworkers (93).

LYCOPODIACEAE

LYCOPODIUM ANNOTINUM L.

A petroleum ether extract and a chloroform extract of the aqueous extractive of the whole plant were both toxic to black carpet beetle larvae, but not to German cockroaches and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

LYCOPODIUM CLAVATUM L. Lycopodium.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

An aqueous extract of the whole plant was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

LYCOPODIUM COMPLANATUM var. FLABELLIFORME Fern.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Quisumbing (179).

An aqueous extract of the fronds was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract. A chloroform extract of the aqueous extractive was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

LYCOPODIUM OBSCURUM L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Quisumbing (179).

LYCOPODIUM QUADRANGULARE Spring.

A petroleum ether extract of the plant was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. An alcohol extract was nontoxic to these species and to Aedes mosquito larvae. A chloroform extract was toxic only to milkweed bugs.--Heal and coworkers (93).

MARSILEACEAE

MARSILEA VESTITA Hook. & Grev.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were all nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito.--Heal and coworkers (93).

OSMUNDACEAE

OSMUNDA CLAYTONIANA L.

An aqueous extract of the rhizomes was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PARMELIACEAE

CETRARIA ISLANDICA Ach. Iceland moss.

Acetone and water extracts of the whole plant were nontoxic to mosquito larvae.--Hartzell (89).

CETRARIA JUNIPERINA Ach.

An aqueous extract of the plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract and a chloroform extract of the aqueous extractive were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

PARMELIA PERFORATA Ach.

An aqueous extract of the plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

PELTIGERACEAE

PELTIGERA CANINA var. MEMBRANACEA Duby.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

POLYPODIACEAE

ADIANTUM PEDATUM L. Maidenhair fern.

Acetone and water extracts of the whole plant were nontoxic to mosquito larvae.--Hartzell (89).

ADIANTUM sp.

An aqueous extract of the whole plant was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

ANEIMIA MEXICANA Klotzsch.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae. The petroleum ether extract was also toxic to webbing clothes moth larvae.--Heal and coworkers (93).

ATHYRIUM PTERORACHIS Christ.

A water suspension of the leaves and stems was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

CHEILANTHES MICROPHYLLA Sw.

An aqueous extract of the whole plant was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CONIOGRAMME JAPONICA (Thunb.) Diels. Synonym: Notogramme japonica.

A water suspension of the leaves was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

DRYOPTERIS BISSETIANA var. TENERIFRONS H. Ito.

A water suspension of the leaves was somewhat toxic and a suspension of the roots was very toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

DRYOPTERIS ERYTHROSORA var. CAUDATA Kakai.

A water suspension of the leaves and stems was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

DRYOPTERIS FILIX-MAS (L.) Schott. Synonym: Aspidium filix-mas.

The powdered rhizome was toxic to armyworms but not to celery leaf tiers, pea aphids, and two-spotted spider mites.--Bottger and Jacobson (36).

The powdered rhizomes from India were ineffective against European corn borer

larvae. A petroleum ether extractive of the rhizomes showed some toxicity to cat fleas, but had no effect on lone star ticks, chiggers, body lice, and Anopheles mosquito larvae, or as a body louse ovicide. The extractive showed some toxicity to adult house flies, but the combined ethyl ether, chloroform, and alcohol extractives of the extracted residue were all nontoxic to house flies. The alcohol extractive was effective as a body louse ovicide at 5 percent but not at 1 percent; it was ineffective against cat fleas, lone star ticks, chiggers, body lice, and Anopheles mosquito larvae. Both the phenol fraction and crude filicin, isolated from the petroleum ether extractive, were highly toxic to adult house flies, showing high paralyzing action and mortality.--Jacobson (108).

An aqueous extract of the leaves was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

DRYOPTERIS MARGINALIS (L.) Gray.

An aqueous extract of the rootstock was slightly toxic to American cockroaches when injected into the blood stream. An alcohol extract of the rootstock was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (233).

GYMNOCARPIUM DRYOPTERIS (L.) Newm.

A water suspension of the leaves, stems, and roots was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

LEPISORUS USSURIENSIS Ching.

A water suspension of the leaves and roots was not toxic to Drosophila hydei larvae, but a suspension of the leaves, stems, and roots was toxic to these larvae.--Yamaguchi and coworkers (233).

NOTHOLAENA SINUATA (Lag.) Kaulf.

An aqueous extract of the whole plant was slightly toxic to American cockroaches when injected into the blood stream.--Heal and coworkers (93).

PELLAEA ORNITHOPUS Hook.

An aqueous extract of the whole plant was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

POLYPODIUM ANGUSTIFOLIUM Sw.

POLYPODIUM NERIIFOLIUM Schkuhr.

Aqueous extracts of whole specimens of these plants were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

POLYPODIUM sp.

An aqueous extract of the rhizomes was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

POLYSTICHUM REFROSO-PALEACEUM Tagawa.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

PTERIDIUM AQUILINIUM var. LATIUSCULUM (Desv.) Underw. Synonym: P. latiusculum.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PTERIDIUM CAUDATUM (L.) Maxon.

An aqueous extract of the leaves was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the stalks was nontoxic to all these insects.--Heal and coworkers (93).

POLYPORACEAE

POLYPORUS OFFICINALIS Fr.

An aqueous extract of the fungus body was nontoxic to American cockroaches

when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SELAGINELLACEAE

SELAGINELLA MYOSURUS (Sw.) Alston.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

STICTACEAE

STICTA PULMONARIA Bir.

An aqueous extract of the fruiting body was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

USNEACEAE

ALECTORIA SARMENTOSA Ach.

An aqueous extract of the whole plant was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

EVERNIA VULPINA Ach.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PHANEROGAMS or SPERMATOPHYTES

ACANTHACEAE

BELOPERONE CALIFORNICA Benth.

An aqueous extract of the stems was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ELYTRARIA CAROLINIENSIS (Walt.) Pers.

An aqueous extract of the plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

JACOBINIA SPICIGERA (Schlecht.) Bailey.

An aqueous extract of the leaves was somewhat toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

JUSTICIA GENDARUSSA Burm. f.

An aqueous extract of the branches and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LEPIDAGATHIS ALOPECUROIDES (Vahl.) R. Br.

An aqueous extract of the whole plant was somewhat toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RHINACANTHUS COMMUNIS Nees.

An aqueous extract of the roots was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the stems and leaves did not affect any of these insects. A petroleum ether extract of the roots was toxic to larvae of the black carpet beetle and webbing clothes moth, but not to German cockroaches and milkweed bugs. An alcohol extract of the roots was slightly toxic to black carpet beetle larvae, but nontoxic to the other species, confused flour beetles, and Aedes mosquito larvae.--Heal and coworkers (93).

RUELLIA CILIOSA Pursh.

RUELLIA TUBEROSA L.

Aqueous extracts of each of these species were nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

THUNBERGIA ALATA Boj.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

THUNBERGIA ERECTA T. Anders.

An aqueous extract of the stems and leaves was slightly toxic to milkweed bugs when used to immerse the insects, but German cockroaches were unaffected by this procedure, and American cockroaches were unaffected when the extract was injected into the blood stream.--Heal and coworkers (93).

ACERACEAE

ACER CARPINIFOLIUM Sieb. & Zucc.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

ACER PLATANOIDES L. Norway maple.

The powdered whole plant was nontoxic to Ixodes and Dermacentor ticks, bedbugs, house flies, Anopheles and Aedes mosquitoes, and Drosophila.--Olenev (163).

ACER RUBRUM L. Red maple.

The wood is very susceptible to termites.--Wolcott (225).

ACTINIDIACEAE

ACTINIDIA sp.

An aqueous extract of the branchlets and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ADOXACEAE

ADOXA MOSCHATELLINA L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AIZOACEAE

AIZOON CANARIENSE L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MESEMBRYANTHEMUM CHILENSE Mol.

MESEMBRYANTHEMUM SAXICOLA.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches when injected into the bloodstream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MESEMBRYANTHEMUM CRYSTALLINUM L.

An aqueous extract of the whole plant was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Both a petroleum ether extract and a chloroform extract of the aqueous extractive showed some toxicity to black carpet beetle larvae, but they were nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Petroleum ether, alcohol, and chloroform extracts of the fruits showed no toxicity to any of these insect species.--Heal and coworkers (93).

MOLLUGO VERTICILLATA L.

German cockroaches were slightly affected after immersion in an aqueous extract of the whole plant, but milkweed bugs were unaffected. The extract was nontoxic to American cockroaches when injected into the blood stream.--Heal and coworkers (93).

NANANTHUS VITTATUS N. E. Br.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PSILOCAULON ABSIMILE N. E. Brown.

An aqueous extract of the stems was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SESUVIUM PORTULACASTRUM L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether, alcohol, and chloroform extracts were highly toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

TETRAGONIA EXPANSA Murr. New Zealand spinach.

A water suspension of the leaves was nontoxic to Drosophila hydei larvae, but a suspension of the leaves, stems, and roots was highly toxic to these larvae.--Yamaguchi and coworkers (233).

TRIANTHEMA PORTULACASTRUM L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ALISMATACEAE

ALISMA SUBCORDATUM Raf.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream; German cockroaches, but not milkweed bugs, were affected after immersion in the extract.--Heal and coworkers (93).

ECHINODORUS CORDIFOLIUS (L.) Griseb.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HYDROCLEIS NYMPHOIDES (Humb. & Bonpl.) Buch.

An aqueous extract of the whole plant was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LOPHOTOCARPUS CALYCINUS (Engelm.) J. G. Sm.

An aqueous extract of the whole plant was slightly toxic to American cockroaches when injected into the blood stream; milkweed bugs, but not German cockroaches, were affected after immersion in the extract--Heal and coworkers (93).

SAGITTARIA LATIFOLIA Willd.

An aqueous extract of the whole plant was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AMARANTHACEAE

ACNIDA ALTISSIMA Riddell.

An aqueous extract of the tops, leaves, and flowers was slightly toxic to American cockroaches when injected into the blood stream; milkweed bugs were unaffected and German cockroaches were slightly affected after immersion in the extract.--Heal and coworkers (93).

ALTERNANTHERA SESSILIS (L.) R. Br. Synonym: Achyranthes sessilis.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A petroleum ether extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle,

webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

DEERINGIA AMARANTHOIDES (Lam.) Merr.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether, alcohol, and chloroform extracts were slightly toxic to black carpet beetle larvae but nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

FROELICHIA CAMPESTRIS Small.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

FROELICHIA DRUMMONDII Moq.

An aqueous extract of the roots and lower parts of the plant was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

IRESINE sp.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TIDESTROMIA LANUGINOSA (Nutt.) Standl. Synonym: Achyranthes lanuginosa.

The powdered stems were ineffective against southern armyworms, melonworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered stems were ineffective against European corn borers. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the stems were effective against codling moth larvae but not against house flies.--Jacobson (108).

TIDESTROMIA OBLONGIFOLIA (S. Wats.) Standl.

An aqueous extract of the whole plant was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AMARYLLIDACEAE

AGAVE AMERICANA L. Century plant.

An infusion of the leaves is used as an insecticide in the Philippine Islands.--Quisumbing (179).

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AGAVE LECHEGUILLA Torr. Lecheguilla.

AGAVE PALMERI Engelm.

AGAVE PARRYI Engelm. var. COUESII (Engelm.) Kearney & Peebles.

Ethanol extractives of the leaves of lecheguilla and of the leaves and the flower heads of the other two species were all ineffective against southern armyworms, pea aphids, two-spotted spider mites, and large milkweed bugs.--Jacobson (108).

AGAVE VIRGINICA L. Synonym: Manfreda virginica.

Aqueous extracts of the whole plant with fruits and of the combined bulbs and leaves were nontoxic to American cockroaches after injection into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

AGAVE sp. Century plant.

An acetone extract of the leaves was nontoxic to mosquito larvae.--Jacobson (108).

BOOPHONE DISTICHA Herb.

An aqueous extract of the bulbs was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs

were unaffected after immersion in the extract.--Heal and coworkers (93).

COOPERIA PEDUNCULATA Herb.

An aqueous extract of the leaves was slightly toxic to American cockroaches when injected into the blood stream. German cockroaches immersed in the extract were slightly affected. An aqueous extract of the bulbs was slightly toxic to American cockroaches and nontoxic to German cockroaches. Petroleum ether, alcohol, and chloroform extracts of the bulbs were toxic to black carpet beetle larvae, but nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

CRINUM ERUBESCENS Ait.

An aqueous extract of the fresh bulbs was very toxic to American cockroaches when injected into the blood stream; milkweed bugs and German cockroaches immersed in the extract were affected slightly and not at all, respectively.--Heal and coworkers (93).

CRINUM MODESTUM Baker.

An aqueous extract of the bulbs was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CRINUM sp.

Petroleum ether, alcohol, and chloroform extracts of the bulbs were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and Aedes mosquito larvae. The alcohol and chloroform extracts showed slight toxicity to larvae of the webbing clothes moth.--Heal and coworkers (93).

FURCRAEA GIGANTEA Vent.

FURCRAEA TUBEROSA Ait.

Both of these plants were nontoxic to house flies, mosquito larvae, and the larvae of several leaf-eating species.--Sievers and coworkers (197).

HABRANTHUS ANDERSONII Herb.

An aqueous extract of the fresh bulbs was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HAEMANTHUS AMARYLLOIDES Jacq.

An aqueous extract of the bulbs was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HIPPEASTRUM PUNICEUM (Lam.) Urban.

HIPPEASTRUM sp.

An aqueous extract was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

HYMENOCALLIS CALATHINA Nichols. Basket flower.

The powdered bulbs were ineffective against melonworms, southern armyworms, and European corn borers.--Jacobson (108).

HYMENOCALLIS sp.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

HYPOXIS DECUMBENS L.

An aqueous extract of the bulbs was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LYCORIS RADIATA Herb. Synonym: Nerine japonica.

A water suspension of the leaves was nontoxic to Drosophila hydei larvae, but a suspension of the combined roots and stems was toxic to the larvae.--Yamaguchi and coworkers (233).

An aqueous extract of the bulbs was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether, alcohol, and chloroform extracts of the bulbs were toxic to black carpet beetle larvae, but not to German

cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

NARCISSUS PSEUDONARCISSUS L. Daffodil.

The powdered leaves were nontoxic to melonworms, cross-striped cabbageworms, and southern armyworms.--Bottger and Jacobson (36).

Petroleum ether, combined ethyl ether-chloroform, and alcohol extractives of the leaves were all nontoxic to codling moth larvae and German cockroaches.--Jacobson (108).

An aqueous extract of the bulbs was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

NERINE LUCIDA Herb.

An aqueous extract of the bulbs was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

POLYANTHES sp.

An aqueous extract of the tubers was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RUNYONIA sp.

Petroleum ether, alcohol, and chloroform extracts of the whole plant were somewhat toxic to black carpet beetle larvae, but nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

SPREKELIA FORMOSISSIMA (L.) Herb.

Petroleum ether, alcohol, and chloroform extracts of the bulbs were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and Aedes mosquito larvae. The alcohol and chloroform extracts were slightly toxic to webbing clothes moth larvae.--Heal and coworkers (93).

ZEPHYRANTHES sp.

Petroleum ether, alcohol, and chloroform extracts of the bulbs were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

ANACARDIACEAE

ANACARDIUM EXCELSUM (H. B. K.) Skeels. Espavel.

The wood is resistant to termites.--Wolcott (226).

An aqueous extract of the stem bark was slightly toxic to American cockroaches and milkweed bugs but not to German cockroaches.--Heal and coworkers (93).

ANACARDIUM OCCIDENTALE L. Cashew, acajou.

The heartwood of this tree is susceptible to termite attack. Oil extracted from the husk of the nuts prevented termite attack on treated wood for only a short time. However a 1-percent solution of anacardic acid, obtained from this oil, prevented termite attack for over three months.--Wolcott (224).

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ANACARDIUM sp.

The wood is susceptible to termites.--Wolcott (225).

COTINUS COGGYGRIA Scop. Smoke tree.

Fustic crystals obtained from this tree were not repellent to termites at considerable dilution.--Wolcott (224).

HEERIA MUCRONATA Bernh.

Aqueous extracts of the bark and stem wood, and also of the stems, were nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

LANNEA AMANIENSIS Engl.

An aqueous extract of the stem bark was slightly toxic to American cockroaches

when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LITHRAEA MOLLEOIDES (Vell.) Engl.

An aqueous extract of the branches and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LOXOPTERYGIUM SAGOTII Hook. f.

MANGIFERA INDICA L. Indian mango.

The wood is susceptible to termites.--Wolcott (225).

METOPIUM BROWNEI (Jacq.) Urban.

An aqueous extract of the bark was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

RHUS AROMATICA Ait. Synonym: R. canadensis.

An acetone extract of the bark was nontoxic to mosquito larvae.--Hartzell (90). An aqueous extract of the branches and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RHUS GLABRA L. Sumac.

Acetone and water extracts of the leaves were nontoxic to mosquito larvae.--Hartzell (89).

RHUS NATALENSIS Bernh.

An aqueous extract of the roots was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SCHINOPSIS LORENTZII (Griseb.) Engelm. Synonym: Quebrachia lorentzii. Quebracho.

Quebracho extract used on susceptible wood did not prevent termite attack.--Wolcott (224).

SCHINOPSIS sp.

Tannin extract was ineffective as a stomach and contact poison.--Anonymous (24).

SCHINUS WEINMANNIAEFOLIUS Mart.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SCLEROCARYA CAFFRA Sond.

Aqueous extracts of the branches and leaves and of the stem bark were slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

SEMECARPUS ANACARDIUM L. Synonym: Anacardium orientale.

The ground seed shells are used in El Salvador as a contact poison against leaf worms, and the powdered seed hulls are used against bird lice.--Wellman and van Severen (221).

SEMECARPUS CUNEIFORMIS Blanco.

Aqueous extracts of the bark and of the leaves were nontoxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extracts.--Heal and coworkers (93).

SPONDIAS MOMBIN L. Synonym: S. lutea. Hog plum.

The wood is very susceptible to termites.--Wolcott (225).

TAPIRIRA GUIANENSIS Aubl.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TAPIRIRA MARCHANDII Engl.

The wood is very susceptible to termites.--Wolcott (225).

ANNONACEAE

ANNONA CHERIMOLA Mill. Synonym: A. tripetala. Cherimoya.

Petroleum ether and chloroform extracts of the seeds were toxic to larvae of the black carpet beetle and webbing clothes moth, slightly toxic to Aedes mosquito larvae, and nontoxic to German cockroaches, milkweed bugs, and Anopheles mosquito larvae. An alcohol extract was toxic only to black carpet beetle larvae.--Heal and coworkers (93).

ANNONA DIVERSIFOLIA Safford.

An aqueous extract of the seeds was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

ANNONA GLABRA L. Alligator apple.

An aqueous extract of the seeds was toxic to American cockroaches when injected into the blood stream; milkweed bugs and German cockroaches were affected slightly and not at all, respectively, after immersion in the extract. A petroleum ether extract of the seeds was toxic to milkweed bugs and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito; it was nontoxic to German cockroaches and Anopheles mosquito larvae. Alcohol and chloroform extracts of the seeds were toxic to larvae of the webbing clothes moth and black carpet beetle, but not to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae.--Heal and coworkers (93).

ANNONA MONTANA Macfad.

An aqueous extract of the branches and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the seeds was toxic to American cockroaches and milkweed bugs, but not to German cockroaches.--Heal and coworkers (93).

ANNONA MURICATA L. Sour sop.

The powdered seed was toxic to southern armyworms and pea aphids, but not to celery leaf tiers, large milkweed bugs, and two-spotted spider mites.--Bottger and Jacobson (36).

The petroleum ether-soluble and -insoluble fractions of an ethyl ether extractive of the seeds were ineffective against adult house flies.--Jacobson (108).

An aqueous extract of the seeds was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were practically unaffected after immersion in the extract. Petroleum ether and chloroform extracts of the seeds were toxic to black carpet beetle larvae, but nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ANNONA PALUSTRIS L.

An aqueous extract of the seeds was very toxic to American cockroaches when injected into the blood stream. Immersion in the extract was toxic to milkweed bugs but not to German cockroaches.--Heal and coworkers (93).

ANNONA RETICULATA L. Custard apple.

ANNONA SQUAMOSA L. Sugar apple.

The seeds and roots were extracted with ethyl ether, and a resinous substance was obtained which is a contact poison of the same order as rotenone against aphids. As a stomach poison it is toxic and repellent to diamondback moth larvae. Its toxicity is less than that of rotenone to the saw-toothed grain beetle. The toxicity is probably due to a glyceride or glycerides of a hydroxylated unsaturated acid or acids of high molecular weight.--Harper and coworkers (87).

The powdered seeds are used in the Philippine Islands as an insecticide and against head lice.--Quisumbing (179).

An aqueous extract of the seeds of A. squamosa was toxic to American cockroaches when injected into the blood stream; immersion in the extract was toxic to milkweed bugs but not to German cockroaches. A petroleum ether extract of the seeds was very toxic to larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito, slightly toxic to milkweed bugs, and nontoxic to German cockroaches and Anopheles mosquito larvae.--Heal and coworkers (93).

Hot-pressed and heat-extracted oils of A. squamosa seeds were highly toxic contact

poisons to pumpkin beetles, cabbage aphids, and house flies; the oil was a stomach poison to sawfly larvae and pumpkin beetles. Neither the mixed fatty acids nor the neutral soap was toxic. Heat and acid treatment of the toxic oil did not reduce its potency, but alkali-refining with 50 percent excess alkali rendered the oil inocuous.--Naidu and coworkers (157).

ANNONA sp.

A dust or paste of the ground seeds is used in El Salvador as a contact poison for poultry lice. The ground seeds are also used against bedbugs and head lice.--Wellman and van Severen (221).

An aqueous extract of the seeds was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

ARTABOTRYS UNCINATUS (Lam.) Merr.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ASIMINA ANGUSTIFOLIA Gray. Synonym: Pityothamnus angustifolius. Pawpaw.

The powdered aerial portion of the plant was ineffective against southern armyworms, southern beet webworms, and European corn borers but had some effect on melonworms. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives showed some toxicity to codling moths but not to house flies.--Jacobson (108).

ASIMINA TRILOBA (L.) Dunal. Synonym: Annona triloba.

An aqueous extract of the bark was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract. An extract of the seeds was nontoxic to American and German cockroaches and did not affect milkweed bugs when they were immersed therein.--Heal and coworkers (93).

CANANGA ODORATA Hook. f. & Thoms. Synonym: Annona odorata. Ylang-ylang.

Isoeugenol, obtained from ylang-ylang oil, synergized pyrethrins only slightly in tests against adult house flies.--Kerr (114).

CLEISTOPHOLIS PATENS Engl. & Diels.

An aqueous extract of the branches, leaves, bark, and roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GUATTERIA sp.

Aqueous extracts of the roots, the fruits, and the stem bark were nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

MONODORA MYRISTICA (Gaertn.) Dunal.

An aqueous extract of the seeds was only slightly toxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract of the seeds was toxic to black carpet beetle larvae, but this extract, as well as petroleum ether and chloroform extracts, was nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

OXANDRA LANCEOLATA.

An aqueous extract of the stem bark was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

POLYALTHIA SUBEROSA (Roxb.) Thw.

An aqueous extract of the roots was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ROLLINIA EXSUCCA A. DC.

UNONOPSIS sp.

An aqueous extract of the stem bark was only slightly toxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

XYLOPIA FRUTESCENS Aubl.

Aqueous extracts of the fruits and of the roots were nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

XYLOPIA MURICATA L.

An aqueous extract of the stem bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the fruits was nontoxic to all of these species of insects.--Heal and coworkers (93).

APOCYNACEAE

AGANOSMA ACUMINATA (Roxb.) G. Don.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

AGANOSMA CYMOSA (Roxb.) G. Don.

Petroleum ether, alcohol, and chloroform extracts were somewhat toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ALLAMANDA CATHARTICA L.

An aqueous extract of the branchlets and leaves was only slightly toxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

ALSTONIA SCHOLARIS (L.) R. Br.

An aqueous extract of the stems and bark was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

ALYXIA OLIVAEFORMIS Gaud.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were affected only slightly after immersion in the extract. A petroleum ether extract of the leaves was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito. An aqueous extract of the branches and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ALYXIA RUSCIFOLIA R. Br.

Aqueous extracts of the roots and of the stem bark were only slightly toxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

AMSONIA ARENARIA Standl.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. A petroleum ether extract of the leaves showed slight toxicity to black carpet beetle larvae, but was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes mosquito. An aqueous extract of the stems was nontoxic to American and German cockroaches and to milkweed bugs.--Heal and coworkers (93).

AMSONIA ELLIPTICA (Thunb.) Roem. & Schult.

A water suspension of the leaves was toxic to Drosophila hydei larvae, but a suspension of the roots was nontoxic.--Yamaguchi and coworkers (233).

AMSONIA GRANDIFLORA Alexander

AMSONIA TABERNAEMONTANA Walt.

Aqueous extracts of the leaves were nontoxic to American and German cockroaches.--Heal and coworkers (93).

AMSONIA HIRTELLA Standl.

An aqueous extract of the whole plant was toxic to American and German cockroaches.--Heal and coworkers (93).

AMSONIA LUDOVICIANA Vail.

An aqueous extract of the roots was nontoxic to American and German cockroaches and to milkweed bugs.--Heal and coworkers (93).

AMSONIA POGONOSEPALA Woodson.

An aqueous extract of the whole plant was nontoxic to American and German cockroaches and to milkweed bugs.--Heal and coworkers (93).

AMSONIA RIGIDA Shuttlw.

An aqueous extract of the stems and roots was nontoxic to American and German cockroaches and to milkweed bugs.--Heal and coworkers (93).

ANODENDRON AFFINE Nakai.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

APOCYNUM ANDROSAEMIFOLIUM L.

An aqueous extract of the roots, leaves and stems was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the roots was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

APOCYNUM CANNABINUM L. Black Indian hemp, hemp dogbane.

An acetone extract of the roots was nontoxic to mosquito larvae.--Hartzell (90).

The powdered leaves were nontoxic to southern armyworms, melonworms, and Hawaiian beet webworms. The powdered twigs and stems were ineffective against southern armyworms, melonworms, cabbage loopers, cross-striped cabbage worms, and Hawaiian beet webworms.--Bottger and Jacobson (36).

The powdered leaves were ineffective against European corn borers. Combined petroleum ether and ethyl ether extracts, as well as combined chloroform and alcohol extracts of the leaves, were nontoxic to house flies, German cockroaches, and codling moths. Extracts of the twigs and stems were effective against codling moth larvae but not against house flies and German cockroaches. The powdered twigs and stems had no effect on European corn borers.--Jacobson (108).

Aqueous extracts of the leaves and of the roots and stems were very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Petroleum ether and chloroform extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. An alcohol extract of the roots was ineffective against German cockroaches, milkweed bugs, and confused flour beetles.--Heal and coworkers (93).

APOCYNUM CANNABINUM var. PUBESCENS (Mitchell) A. DC.

Aqueous extracts of the branches and leaves and of the stems and roots were only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

APOCYNUM SIBIRICUM Jacq.

An aqueous extract of the branches, leaves, and roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether, alcohol, and chloroform extracts showed some toxicity to black carpet beetle larvae, but were nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ASPIDOSPERMA EXCELSUM Benth.

The wood is susceptible to termites.--Wolcott (225).

ASPIDOSPERMA MEGALOCARPON Muell. Arg.

ASPIDOSPERMA POLYNEURON Muell. Arg.

An aqueous extract of the bark was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ASPIDOSPERMA NITIDUM Benth.

Aqueous extracts of the bark were only slightly toxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract. A petroleum ether extract was ineffective against Aedes mosquito larvae.--Heal and coworkers (93).

CAMERARIA BELIZENSIS Standl.

An aqueous extract of the roots was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CAMERARIA LATIFOLIA L.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches and only slightly toxic to German cockroaches.--Heal and coworkers (93).

CARISSA CARANDAS L.

An aqueous extract of the branchlets and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CERBERA TANGHIN Hook. Ordeal bean.

The powdered seeds from Madagascar were ineffective against Mexican bean beetle larvae.--Hansberry and Clausen (86).

DIPLORRHYNCUS MOSSAMBICENSIS Benth.

An aqueous extract of the roots was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ECHITES PELTATA Vell.

An aqueous extract of the stems, leaves, and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ECHITES RUBRO-VENOSA Linden

An aqueous extract of the stems and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ECHITES UMBELLATA Jacq.

An aqueous extract of the tubers was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An extract of the branches and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ELYTROPUS CHILENSIS Muell. Arg.

An aqueous extract of the stems and leaves was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether, alcohol, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An aqueous extract of the roots was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

FERNALDIA PANDURATA (A. DC.) Woodson. Synonym: Urechites Karwinskii.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

FORSTERONIA CORYMBOSA G. F. W. Mey.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract was ineffective against German cockroaches and the larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

FORSTERONIA LEPTOCARPA (Hook. & Arn.) A. DC. Synonym: F. brasiliensis.

An aqueous extract of the stems and leaves was toxic to American cockroaches

when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GONIOMA KAMASSI E. Mey.

Aqueous extracts of the bark and of the branches and leaves were nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HAPLOPHYTON CIMICIDUM A. DC. Cockroach plant.

The plant has been used to destroy head lice and cockroaches.--Higbee (94).

The powdered roots, leaves, and stems were ineffective against Mexican bean beetle larvae.--Hansberry and Clausen (86).

A 10-percent dust of the crude alkaloids from the roots was toxic to southern armyworms, imported cabbageworms, celery leaf tiers, Autographa, squash bugs, and striped blister beetles. The powdered stems were toxic to melonworms but not to cross-striped cabbageworms, Hawaiian beet webworms, and southern armyworms.--Bottger and Jacobson (36).

The powdered stems were ineffective against European corn borers, but aqueous extracts of the stems were highly toxic to house flies. The crude alkaloids from the plant were toxic to codling moth larvae but not to house flies or European corn borers.--Jacobson (108).

An aqueous extract of the stems was toxic to German and American cockroaches, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes. An aqueous extract of the fruits was toxic to American cockroaches, but an extract of the roots was only slightly toxic to this insect.--Heal and coworkers (93).

The crude plant alkaloid was toxic to European corn borers, Mexican bean beetle larvae, Colorado potato beetle larvae and adults, grasshoppers, eggplant lace bugs, and codling moth larvae. The alkaloids haplophytine and cimicidine were isolated from the crude material. They are both toxic to German cockroaches on contact, ingestion, and injection.--Rogers and coworkers (187).

HOLARRHENA ANTIDYSENTERICA Wall.

An aqueous extract of the leaves was only slightly toxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HOLARRHENA FEBRIFUGA Klotzsch.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An extract of the roots was ineffective against all these species.--Heal and coworkers (93).

MACROSIPHONIA BRACHYSIPHON Gray.

An aqueous extract of the whole plant was only slightly toxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract. An extract of the stems and leaves was slightly toxic to both species of insects. Alcohol and petroleum ether extracts of the stems and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

MACROSIPHONIA HYPOLEUCA Muell. Arg.

An aqueous extract of the branchlets was toxic to milkweed bugs but not to German and American cockroaches.--Heal and coworkers (93).

MACROSIPHONIA LONGIFLORA Muell. Arg.

An aqueous extract of the tops and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs. Alcohol and petroleum ether extracts were ineffective against German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

MACROSIPHONIA PETRAEA (St. Hil.) K. Schum.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MALOUETIA HEUDELOTII A. DC.

Aqueous extracts of the branches and leaves, of the roots, and of the stems were all nontoxic to German cockroaches, webbing clothes moths, and black carpet beetles.--Heal and coworkers (93).

MALOUETIA OBTUSILOBA A. DC.

An aqueous extract of the leaves was nontoxic to American cockroaches when injected into the blood stream; German cockroaches were slightly affected, and milkweed bugs not affected at all after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the branchlets and leaves, and of the bark were toxic to black carpet beetle larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An aqueous extract of the roots was slightly toxic to larvae of the black carpet beetle and the webbing clothes moth, and nontoxic to German cockroaches, milkweed bugs, and Aedes mosquito larvae.--Heal and coworkers (93).

MALOUETIA TAMAQUARINA (Aubl.) A. DC.

An aqueous extract of the branches and leaves was toxic to American cockroaches and black carpet beetles, but not to German cockroaches, milkweed bugs, webbing clothes moths, and Aedes and Anopheles mosquitoes. Petroleum ether and chloroform extracts of the stem bark were somewhat toxic to black carpet beetle larvae but nontoxic to the other species.--Heal and coworkers (93).

MANDEVILLA ANGUSTIFOLIA (Malme.) Woodson.

An aqueous extract of the stems was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MANDEVILLA BRACHYLOBA (Merell. Arg.) K. Schum.

An aqueous extract of the stems and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MANDEVILLA BRIDGESII (Muell. Arg.) Woodson.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches, but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MANDEVILLA FOLIOSA Hemsl.

The powdered plant was ineffective against Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the stems and leaves was toxic to German cockroaches, webbing clothes moths, and black carpet beetle larvae, slightly toxic to American cockroaches, and nontoxic to milkweed bugs and Aedes mosquito larvae. An alcohol extract was nontoxic to all these species, as well as to Anopheles mosquito larvae. An aqueous extract of the leaves, fruits, and seeds was very toxic to American cockroaches, slightly toxic to German cockroaches, and nontoxic to milkweed bugs.--Heal and coworkers (93).

MANDEVILLA HIRSUTA (Rich.) K. Schum.

An aqueous extract of the branches and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MANDEVILLA LAXA (Ruiz & Pavon) Woodson.

An aqueous extract of the stems and leaves was toxic to American cockroaches and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and petroleum ether extracts were ineffective against all these species. An aqueous extract of the roots was highly toxic to American cockroaches, but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MANDEVILLA MOLLISSIMA (H. B. K.) K. Schum.

An aqueous extract of the whole plant was toxic to American cockroaches and nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito. A petroleum ether extract was toxic to black carpet beetle larvae only.--Heal and coworkers (93).

MANDEVILLA PENTLANDIANA (A. DC.) Woodson.

MANDEVILLA SUBSAGITTATA (Ruiz & Pavon) Woodson.

An aqueous extract of the stems and leaves was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

MANDEVILLA sp.

Aqueous extracts of the stems and of the branchlets and leaves were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MASCARENHASIA ELASTICA K. Schum.

Aqueous extracts of the roots and of the branchlets and leaves were nontoxic to American cockroaches when injected into the blood stream. German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

MELODINUS MONOGYNUS Roxb.

An aqueous extract of the branches, leaves, and bark was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

NERIUM INDICUM Mill. Synonym: N. odorum.

Petroleum ether, alcohol, and chloroform extracts of the roots were all toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

NERIUM OLEANDER L. Common oleander.

The powdered leaves were ineffective against southern armyworms, and only slightly toxic to melonworms and European corn borers. Combined petroleum ether and ethyl ether extractives, as well as combined alcohol and chloroform extractives, were ineffective against house flies but somewhat effective against codling moths.--Jacobson (108).

Aqueous extracts of the leaves and of the combined branches and leaves were very toxic to American cockroaches and black carpet beetle larvae, but nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol extracts were ineffective against all these species (not tested against American cockroaches). Aqueous extracts of the roots and of the flowers were toxic to black carpet beetle larvae only.--Heal and coworkers (93).

ODONTADENIA GRANDIFLORA Miq.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ODONTADENIA PUNCTICULOSA Pulle.

An aqueous extract of the stems and leaves was highly toxic to American cockroaches but nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito. A petroleum ether extract was toxic to the milkweed bug and the black carpet beetle. An alcohol extract was nontoxic to all of these species.--Heal and coworkers (93).

PLUMERIA MULTIFLORA Standl.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PLUMERIA RUBRA L. Mexican frangipani.

An aqueous extract of the stems was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PLUMERIA sp.

An aqueous extract of the bark was nontoxic to American and German cockroaches. An alcohol extract of the bark was nontoxic to Aedes mosquito larvae.--Heal and coworkers (93).

PLUMERIOPSIS AHOUAI (L.) Rusby. Synonym: Cerbera ahouai.

An aqueous extract of the leaves was very toxic to American cockroaches, somewhat toxic to black carpet beetle larvae and nontoxic to German cockroaches, milkweed bugs, webbing clothes moths, and Aedes and Anopheles mosquitoes. Petroleum ether and alcohol extracts were somewhat toxic to black carpet beetle larvae and nontoxic to the other species of insects.--Heal and coworkers (93).

PRESTONIA AGGLUTINATA (Jacq.) Woodson.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PRESTONIA MOLLIS H. B. K.

An aqueous extract of the stems and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PTERALYXIA MACROCARPA K. Schum.

An aqueous extract of the fruits was somewhat toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the branches and leaves was nontoxic to these species.--Heal and coworkers (93).

RAUWOLFIA HETEROPHYLLA Willd.

An aqueous extract of the branchlets and leaves was somewhat toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract was nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RAUWOLFIA HIRSUTA Jacq. Synonym: R. canescens. Quita trancazo.

Talc dusts containing 10 percent of the combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the leaves and stems were ineffective against southern armyworms and melonworms, but showed some effect on southern beet webworms.--Bottger and Jacobson (36).

Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were ineffective against European corn borers, house flies, and codling moth larvae.--Jacobson (108).

RAUWOLFIA SANDWICENSIS A. DC.

An aqueous extract of the leaves was weakly toxic to German cockroaches and nontoxic to American cockroaches.--Heal and coworkers (93).

RAUWOLFIA SERPENTINA Benth.

An aqueous extract of the branches and leaves was somewhat toxic to American and German cockroaches and nontoxic to milkweed bugs.--Heal and coworkers (93).

RAUWOLFIA TETRAPHYLLA L. Synonym: R. nitida.

The wood is susceptible to termites.--Wolcott (224).

Aqueous extracts of the fruits, and of the stem bark were both toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RAUWOLFIA VOMITORIA Afzel.

An aqueous extract of the roots was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

RHABDADENIA BIFLORA (Jacq.) Muell. Arg.

An aqueous extract of the stems was nontoxic to American cockroaches when injected into the blood stream and German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

RHABDADENIA RAGONESEI Woodson.

An aqueous extract of the stems and leaves was highly toxic to American cockroaches, but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RHAZYA STRICTA Deone.

An aqueous extract of the stems and roots was somewhat toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

STEMMADENIA GLABRA Benth.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the branchlets and leaves was somewhat toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

STROPHANTHUS DIVARICATUS Wall.

The powdered seed pods and roots showed little toxicity to bean aphids and to the larvae of silkworms and Mexican bean beetles.--Lee and Hansberry (129).

The powdered roots were toxic to bean aphids.--Chiu and coworkers (48).

STROPHANTHUS KOMBE Oliv. Strophanthus.

An acetone extract of the seeds was nontoxic to mosquito larvae.--Hartzell (90).

TABERNAEMONTANA AUSTRALIS Muell. Arg.

TABERNAEMONTANA HETEROPHYLLA Vahl.

TABERNAEMONTANA MAURITIANA Poir.

Aqueous extracts of the branchlets and leaves of each of these species were nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

TABERNAEMONTANA GRANDIFLORA Jacq. Synonym: Stemmadenia grandiflora.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

TABERNAEMONTANA OPPOSITIFOLIA (Spreng.) Urban.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TABERNAEMONTANA sp.

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

TABERNANTHE IBOGA Baill.

An aqueous extract of the roots was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TANGHINIA VENENIFERA Thou.

Aqueous, alcohol, and petroleum ether extracts of the seeds were all toxic to black carpet beetle larvae, but nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

THEVETIA GAUMERI Hemsl.

An aqueous extract of the branches and leaves was very toxic to American cockroaches and black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to the other species. Aqueous extracts of the fruits and of the roots were highly toxic to American cockroaches and black carpet beetle larvae, somewhat toxic to milkweed bugs, and nontoxic to German cockroaches, webbing clothes moths, and Aedes mosquito larvae.--Heal and coworkers (93).

THEVETIA PERUVIANA (Pers.) Merr. Synonym: Cerbera thevetia. Jacapa, yellow oleander.

The kernels are a potent insecticide, and are especially effective against aphids.--Cherian and Ramachandran (44).

The active constituents of the plant are the glucoside thevetin and an unidentified compound of even greater toxicity. Extracts of the seeds are effective as contact insecticides.--Gattefossé (70).

Thevetin and an unidentified constituent, isolated by cold water extraction from all parts of the plant except the leaves and the pulp of the fruit, are insecticidal.--Anonymous (18).

An acetone extract of the kernels showed some toxicity to adult chrysanthemum aphids and potato aphids, but had no effect on the sawtoothed grain beetle and the diamondback moth. An aqueous extract of the kernels also showed some activity against chrysanthemum aphids. Aqueous and acetone extracts of the shell and debris of the nuts had no effect on any of these insects.--Tattersfield and coworkers (209).

An acetone extract of the seeds was effective against codling moth larvae but not against German cockroaches.--Jacobson (108).

An aqueous extract of the fruits was toxic to American cockroaches and black carpet

beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae only. An aqueous extract of the leaves showed some toxicity to American cockroaches but not to the other species. Alcohol and petroleum ether extracts of the leaves were nontoxic to all the above species.--Heal and coworkers (93).

THEVETIA OVATA A. DC.

An aqueous extract of the fruits was very toxic to American cockroaches and black carpet beetle larvae, but nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but nontoxic to the other insect species.--Heal and coworkers (93).

THEVETIA THEVETIOIDES (H. B. K.) K. Schum.

The powdered seeds were ineffective against Mexican bean beetle larvae.--Hansberry and Clausen (86).

TONDUZIA LONGIFOLIA (A. DC.) Markgr.

An aqueous extract of the bark was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract. An alcohol extract was ineffective against German cockroaches and milkweed bugs.--Heal and coworkers (93).

TRACHELOSPERMUM DIFFORME (Walt.) Gray.

An aqueous extract of the tops was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

URECHITES LUTEA (L.) Britt. Synonym: U. suberecta.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

An acetone extract of the leaves was toxic to mosquito larvae.--Jacobson (108).

VALLESIA GLABRA Link.

An aqueous extract of the branches and leaves was somewhat toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

VINCA MINOR L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

VINCA ROSEA L. Synonym: Lochnera rosea.

German cockroaches and milkweed bugs were unaffected after immersion in an aqueous extract of the branchlets and leaves. An alcohol extract was likewise nontoxic to these insects.--Heal and coworkers (93).

VOACANGA GLOBOSA (Blanco) Merr.

An aqueous extract of the fruits was highly toxic to American cockroaches but nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and petroleum ether extracts were nontoxic to German cockroaches, milkweed bugs, webbing clothes moths, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

AQUIFOLIACEAE

ILEX CORIACEA (Pursh.) Chapm.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ILEX GLABRA (L.) Gray.

An aqueous extract of the fruits was toxic to American cockroaches, but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ILEX PARAGUARIENSIS A. St. Hil. Paraguay tea.

Acetone and water extracts of the leaves were ineffective against mosquito larvae.--Hartzell (89).

ILEX VERTICILLATA (L.) Gray.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs, but an extract of the fruits was highly toxic to both species of cockroaches. Alcohol and petroleum ether extracts of the fruits were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, webbing clothes moths, and Anopheles mosquito larvae. An aqueous extract of the seeds was nontoxic to all these species as well as Aedes mosquitoes.--Heal and coworkers (93).

ARACEAE

ACORUS CALAMUS L. Sweet rush, sweetflag.

The powdered roots killed house flies and Anopheles mosquitoes in 40 minutes when used as a dust. Aqueous and alcohol extracts of the roots repelled Ixodes ticks for 3 days.--Mironov (149).

The air-dried rhizomes collected in the fall contained 1.3 percent essential oil and 0.62 percent of an alkaloid, calamine, that possibly acts as a contact poison to body lice. The powdered roots killed lice up to 100 percent in 5 to 13 hours at 37°C., but were somewhat less effective at 26° C. The powdered leaves were less toxic.--Rubinstein (188).

The powdered stems are effectively employed in some parts of India to kill fleas. A cold water extract of the stems killed 100 percent of mosquito larvae in 2 hours--Pendse and coworkers (167).

An acetone extract of the root was nontoxic to mosquito larvae.--Hartzell (90).

The finely-powdered rhizome, when mixed with various grains, kept these grains free from insect damage for long periods of time. Grain containing 2 pounds of the powder per 100 pounds showed a great degree of protection over a period of one year. The dried rhizomes and leaves, as well as their water infusions containing a little soap, were effective against crop pests such as plant lice and beetle grubs. The powdered roots were effective against flies, coconut beetle grubs, clothes moths, fowl lice, and bedbugs, but not against bedbug eggs.--Subramaniam (205).

The powdered root was effective against bird lice, clothes moths, and bedbugs.--Subramaniam (204).

An aqueous extract of the roots was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract. An alcohol extract of the roots was nontoxic to larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

AMORPHOPHALLUS APHYLLUS (Hook.) Hutchins.

An aqueous extract of the corms was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the leaves was nontoxic to these insects.--Heal and coworkers (93).

ANTHURIUM HOOKERI Kunth. Synonym: A. tetragonum.

An aqueous extract of the whole plant was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ANTHURIUM RECUSATUM Schott.

An aqueous extract of the stems and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs. Aqueous extracts of the leaves and twigs and of the upper parts of the plant were nontoxic to these insects.--Heal and coworkers (93).

ARISAEMA DRACONTIUM (L.) Schott.

An aqueous extract of the corms was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ARISAEMA ERUBESCENS (Wall.) Schott.

The powdered root was fairly toxic to Mexican bean beetle larvae, but was ineffective against silkworm larvae and bean aphids.--Lee and Hansberry (129).

ARISAEMA PURPUROGALEATUM.

The powdered root showed fair toxicity to Mexican bean beetle larvae and bean

aphids but had no effect on silkworm larvae. Alcohol, chloroform, and acetone extracts had no effect on bean aphids.--Lee and Hansberry (129).

ARISAEMA QUINATUM (Nutt.) Schott. Prester-john.

ARISAEMA SERRATUM (Thunb.) Schott.

Aqueous extracts of the bulbs of *A. quinatum* and of whole *A. serratum* were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

ARISAEMA TRIPHYLLUM (L.) Schott. Wild turnip.

An aqueous extract of the corms was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

An acetone extract of the roots was inefective against mosquito larvae.--Hartzell (90).

ARISAEMA URASHIMA Hara.

Water suspensions of the leaves, stems, and roots were all nontoxic to *Drosophila hydei* larvae, but a suspension of the seeds was toxic to the larvae.--Yamaguchi and coworkers (233).

ARUM ITALICUM Mill.

Aqueous extracts of the rhizomes and of the tubers were nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

ASTEROSTIGMA VERMITOXICUM Griseb.

An aqueous extract of the tubers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ASTEROSTIGMA sp.

An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CALADIUM BICOLOR Vent.

The powdered leaves are used as an insecticide in the Philippine Islands.--Quisumbing (179).

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

CALADIUM sp.

The powdered leaves, petioles, and crown plus roots each showed little or no toxicity to melonworms, diamonback moth larvae, *Diabrotica bivittata*, cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

COLOCASIA ESCULENTA (L.) Schott. Synonym: *Caladium esculentum*.

An aqueous extract of the whole plant was toxic to American cockroaches, but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DIEFFENBACHIA SEQUINE (Jacq.) Schott.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating insects.--Sievers and coworkers (197).

The powdered leaves and stems showed little or no toxicity to melonworm larvae, bean leaf beetles, cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

An aqueous extract of the bark was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract. An aqueous extract of the stems and leaves was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. Petroleum ether, alcohol, and chloroform extracts of the combined stems and leaves, leaves, and roots were somewhat toxic to black carpet beetle larvae, but nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

DRACUNCULUS CANARIENSIS Kunth.

An aqueous extract of the tubers was very toxic to American cockroaches when injected into the blood stream, but German

cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LAGENANDRA TOXICARIA Dalz. Synonym: L. ovata.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether, alcohol, and chloroform extracts of the roots were somewhat toxic to black carpet beetle larvae, but nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

LASIA HETEROPHYLLA Schott.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LYSICHITUM AMERICANUM Hultén & St. John.

An aqueous extract of the whole plant was quite toxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were affected after immersion in the extract. An aqueous extract of the leaves was toxic to both species of cockroaches but not to milkweed bugs, while an extract of the shoots was toxic to American cockroaches and milkweed bugs but not to German cockroaches. An extract of the tubers was toxic to American cockroaches only.--Heal and coworkers (93).

MONTRICHARDIA ACULEATUM Crueg.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ORONTIUM AQUATICUM L.

An aqueous extract of the whole plant was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

PELTANDRA GLAUCA (Ell.) Feay.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PELTANDRA VIRGINICA (L.) Kunth.

An aqueous extract of the underground parts was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. Petroleum ether, alcohol, and chloroform extracts showed some toxicity to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An aqueous extract of the combined fruits, tops, and roots was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

PHILODENDRON BIPINNATIFIDUM Schott.

An aqueous extract of the fruits was very toxic to American cockroaches when injected into the blood stream. German cockroaches, but not milkweed bugs, were affected after immersion in the extract. An extract of the stems and inflorescence was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PHILODENDRON HASTATUM Koch & Sell.

An aqueous extract of the stems and leaves was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. Petroleum ether, alcohol, and chloroform extracts of the leaves were somewhat toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

PINELLIA TERNATA (Thunb.) Breit.

The powdered root was nontoxic to southern armyworms, Hawaiian beet webworms, and southern beet webworms.--Bottger and Jacobson (36).

PINELLIA TRIPARTITA Schott.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German

cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PISTIA STRATIOTES L.

An aqueous extract of one sample of whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An extract of a second sample of whole plant was nontoxic to all three species of insects.--Heal and coworkers (93).

RHAPHIDOPHORA DECURSIVA (Roxb.) Schott.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RHODOSPATHA sp.

An aqueous extract of the stems and leaves was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. Petroleum ether, alcohol, and chloroform extracts were slightly toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

SPATHIPHYLLUM CUSPIDATUM Schott.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SYMPLOCARPUS FOETIDUS (L.) Nutt. Skunk cabbage.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).
Aqueous extracts of the fruits and of the roots were nontoxic to American and German cockroaches.--Heal and coworkers (93).

SYNGONIUM AURITUM (L.) Schott.

An aqueous extract of the stems was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the upper parts and leaves was nontoxic to American and German cockroaches. Petroleum ether or alcohol extracts of many parts of this plant showed some toxicity to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

SYNGONIUM PODOPHYLLUM Schott.

An aqueous extract of the combined stems and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An alcohol extract showed some toxicity to Aedes mosquito larvae, but was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Anopheles mosquito.--Heal and coworkers (93).

SYNGONIUM sp.

An alcohol extract of the stems and leaves was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes. A petroleum ether extract of the whole plant was toxic only to black carpet beetle larvae.--Heal and coworkers (93).

XANTHOSOMA BELOPHYLLUM Kunth.

An aqueous extract of the branchlets and leaves showed some toxicity to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

ZAMIOCULCAS LODDIGESII Schott.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ARALIACEAE

ACANTHOPANAX SEPTEMLOBUS Koidz.

An aqueous extract of the branchlets and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ARALIA CALIFORNICA S. Wats.

An aqueous extract of the roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ARALIA ELATA Seem.

A water suspension of the leaves was nontoxic to Drosophila hydei larvae, but a suspension of the roots was highly toxic to the larvae.--Yamaguchi and coworkers (233).

An aqueous extract of the branches and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether, alcohol, and chloroform extracts showed some toxicity to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and confused flour beetles and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

ARALIA HUMILIS Cav.

Aqueous extracts of the stems and the roots were quite toxic to American cockroaches but not to German cockroaches. A petroleum ether extract of the stems showed some toxicity to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract of the stems was nontoxic to all these insect species.--Heal and coworkers (93).

ARALIA NUDICAULIS L.

An aqueous extract of the roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ARALIA RACEMOSA L.

An aqueous extract of the stems and roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ARALIA SPINOSA L. False prickly ash, Hercules club.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An extract of the fruits was nontoxic to all these species. An alcohol extract of the roots showed some toxicity to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

Petroleum ether, ethyl ether, and chloroform extractives of the bark, as well as petroleum ether and ethyl ether extractives of the twigs and stems, were all ineffective against house flies.--Jacobson (108).

CUSSONIA SPICATA Thunb.

An aqueous extract of the stem bark was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

DIDYMOPANAX MOROTOTONI (Aubl.) Decne. & Planck.

An aqueous extract of the roots was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. An alcohol extract was somewhat toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Petroleum ether and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

DIDYMOPANAX TREMULUM Krug & Urban.

An aqueous extract of the branchlets and leaves was highly toxic to American cockroaches and nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Alcohol, petroleum ether, and chloroform extracts showed some toxicity to black carpet beetle larvae.--Heal and coworkers (93).

GILIBERTIA ARBOREA (L.) March.

An aqueous extract of the branches and leaves was toxic to American cockroaches when injected into the blood stream but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

HEDERA HELIX L.

An aqueous extract of the leaves was highly toxic to American cockroaches when injected into the bloodstream, but German

cockroaches were unaffected after immersion in the extract. Petroleum ether and alcohol extracts showed some toxicity to black carpet beetle larvae, but not to the German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PENTAPANAX ANGELICIFOLIUM Griseb.

An aqueous extract of the branches and leaves was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. The extract was nontoxic to confused flour beetles and larvae of the webbing clothes moth and Aedes mosquito but somewhat toxic to black carpet beetle larvae. Alcohol and petroleum ether extracts gave the same results as did the aqueous extract.--Heal and coworkers (93).

SCHEFFLERA sp.

An aqueous extract of the leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An extract of the roots was nontoxic to all these insects. Petroleum ether, alcohol, and chloroform extracts of the combined leaves and roots were all nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

ARISTOLOCHIACEAE

ARISTOLOCHIA ARGENTINA Griseb.

An aqueous extract of the branchlets and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ARISTOLOCHIA BRACTEATA Retz. Kidamari.

A cold-water extract of the leaves and stems gave a complete kill of mosquito larvae in 17 hours.--Pendse and coworkers (167).

ARISTOLOCHIA BRASILIENSIS Mart. & Zucc.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs. Extracts of the stems and leaves showed some toxicity to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

ARISTOLOCHIA BREVIPES Benth.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ARISTOLOCHIA CYMBIFERA Mart. & Zucc. Barbasco, paté.

An acetone extract of the rhizomes was nontoxic to mosquito larvae.--Jacobson (108).

Aqueous extracts of the roots and stems showed some toxicity to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ARISTOLOCHIA DENSIVENIA Engl.

An aqueous extract of the stems and leaves showed some toxicity to American cockroaches but not to German cockroaches and milkweed bugs. An extract of the roots was nontoxic to all these insects.--Heal and coworkers (93).

ARISTOLOCHIA MACROURA Gomez.

An aqueous extract of the whole plant showed some toxicity to American cockroaches, but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ARISTOLOCHIA MAXIMA Jacq.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

ARISTOLOCHIA RETICULATA Nutt.

An aqueous extract of the roots was very toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

Water and acetone extracts of the roots were nontoxic to mosquito larvae.--Hartzell (89).

ARISTOLOCHIA SERPENTARIA L. Serpentaria.

Water and acetone extracts of the roots were nontoxic to mosquito larvae.--Hartzell (89).

Aqueous extracts of the roots showed some toxicity to American cockroaches but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. The extracts were somewhat toxic to black carpet beetle larvae. Petroleum ether extracts were nontoxic to all these insects.--Heal and coworkers (93).

ARISTOLOCHIA TRILOBATA L.

ARISTOLOCHIA WATSONI Woot. & Standl.

Aqueous extracts of the roots and stems of A. trilobata and of the roots of A. watsoni were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ARISTOLOCHIA sp.

An aqueous extract of the roots was somewhat toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

ASARUM ARIFOLIUM Michx.

Methyl isoeugenol, obtained from the essential oil, increased the toxicity of a standard pyrethrum spray to adult house flies.--Kerr (114).

ASARUM CANADENSE L. Snakeroot, wild ginger.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

An ethyl ether extract of the roots was nontoxic to house flies and showed no synergism with pyrethrins.--Jacobson (108).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ASARUM VIRGINICUM L.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ASCLEPIADACEAE

ARAUJIA GRANDIFLORA Morong.

ARAUJIA SERICIFERA var. HORTORUM (Fourne.) Malme

Aqueous extracts of the branchlets and leaves of A. grandiflora were nontoxic to American and German cockroaches. Extracts of the branchlets and leaves of A. sericifera were nontoxic to both species of cockroaches as well as milkweed bugs.--Heal and coworkers (93).

ASCLEPIAS CURASSAVICA L.

An aqueous extract of the stems and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ASCLEPIAS ERIOCARPA Benth.

An aqueous extract of the stems and leaves was highly toxic to American cockroaches but not to German cockroaches. Petroleum ether and alcohol extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An aqueous extract of the whole plant was highly toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ASCLEPIAS KANSANA Vail.

An aqueous extract of the fruits and roots was nontoxic to German and American cockroaches, and an alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes mosquito but toxic to black carpet beetle larvae.--Heal and coworkers (93)

ASCLEPIAS LABRIFORMIS Jones. Milkweed.

The powdered stems were nontoxic to melonworms, southern armyworms, and blister beetles.--Bottger and Jacobson (36).

The powdered stems were toxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the stems were ineffective against codling moths and house flies.--Jacobson (108).

Aqueous extracts of the whole plant and of the stems and leaves were very toxic to American cockroaches but not to German cockroaches and milkweed bugs. Petroleum ether, alcohol, and chloroform extracts of the whole plant were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ASCLEPIAS SPECIOSA Torr.

An aqueous extract of the roots was nontoxic to American cockroaches. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ASCLEPIAS STENOPHYLLA Gray. Synonym: Acerates angustifolia.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches when injected into the blood stream, and German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

ASCLEPIAS SYRIACA L. Milkweed.

Water and acetone extracts of the stems and of the leaves were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the roots was highly toxic to American cockroaches but not to German cockroaches. Petroleum ether, alcohol, and chloroform extracts of the roots were toxic only to black carpet beetle larvae.--Heal and coworkers (93).

ASCLEPIAS TUBEROSA L.

An aqueous extract of the roots was toxic to American and German cockroaches but not to milkweed bugs.--Heal and coworkers (93).

ASCLEPIODORA VIRIDIS (Walt.) Gray.

An aqueous extract of the leaves was toxic to American cockroaches wnen injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was toxic to both species of cockroaches but not to milkweed bugs.--Heal and coworkers (93).

BLEPHARODON MUCRONATUM (Schlecht.) Decne.

An aqueous extract of the stems and leaves was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

CALOTROPIS GIGANTEA (L.) R. Br.

Some plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CALOTROPIS PROCERA Ait. Swallowwort.

An aqueous extract of the leaves was highly toxic to American cockroaches but not to German cockroaches. Alcohol, petroleum ether, and chloroform extracts of the leaves and of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract of the branches was nontoxic to all these insects.--Heal and coworkers (93).

CEROPEGIA DICHOTOMA Haw.

An aqueous extract of the stems was toxic to American and German cockroaches but not to milkweed bugs.--Heal and coworkers (93).

CRYPTOSTEGIA GRANDIFLORA R. Br.

An aqueous extract of the stems was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were somewhat toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

CYNANCHUM NIGRUM (L.) Pers. Synonym: Vincetoxicum nigrum.

An aqueous extract of portions of the plant with leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CYNANCHUM sp.

The plant showed little toxicity to silkworm and Mexican bean beetle larvae and to bean aphids.--Lee and Hansberry (129).

DAEMIA EXTENSA R. Br.

DAEMIA TOMENTOSA Pomel. Synonym: D. cordata.

An aqueous extract of D. extensa was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of D. tomentosa was toxic to both species of cockroaches but not to milkweed bugs.--Heal and coworkers (93).

EDISONIA PUBIFLORA (Decne.) Small.

An aqueous extract of the roots was toxic to American cockroaches, somewhat toxic to German cockroaches, and nontoxic to milkweed bugs.--Heal and coworkers (93).

FUNASTRUM BONARIENSE (Hook. & Arn.) Schlechter.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

FUNASTRUM GRACILE (Decne.) Schlechter.

An aqueous extract of the stems was toxic to American cockroaches but not to German cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were somewhat toxic to larvae of the black carpet beetle and webbing clothes moth but nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and Aedes mosquito larvae.--Heal and coworkers (93).

GONOLOBUS GONOCARPOS (Walt.) Perry. Synonym: Vincetoxicum gonocarpos.

Aqueous extracts of the pods, roots, and stems and leaves were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GONOLOBUS LAEVIS Michx.

An aqueous extract of the whole plant was somewhat toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

IBATIA MARITIMA (L.) Decne.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LACHNOSTOMA ARIZONICUM Gray.

An aqueous extract of the stems was nontoxic to American cockroaches.--Heal and coworkers (93).

MARSDENIA CLAUSA R. Br.

An aqueous extract of the stems and leaves was nontoxic to American and German cockroaches. Alcohol, petroleum ether, and chloroform extracts of the leaves showed some toxicity to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

MARSDENIA CUNDURANGO Nichols. Condurango.

An acetone extract of the bark was nontoxic to mosquito larvae.--Hartzell (90).

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MARSDENIA MACROPHYLLA Fourn.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MELLICHAMPIA LIGULATA.

An aqueous extract of the stems was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

MORRENIA BRACHYSTEPHANA Griseb.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PERIPLOCA LAEVIGATA Ait.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PODOSTIGMA PEDICELLATUM (Walt.) Vail.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SARCOSTEMMA BREVISTIGMA Wight & Arn.

An aqueous extract of the stems was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

VINCETOXICUM PALUSTRE (Pursh) Gray. Synonym: Seutera palustris.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BALSAMINACEAE

IMPATIENS CAPENSIS Meerb. Synonym: I. biflora.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the roots, leaves, and stems was nontoxic to these insect species.--Heal and coworkers (93).

BATIDACEAE

BATIS MARITIMA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BEGONIACEAE

BEGONIA REX Putz.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BERBERIDACEAE

BERBERIS ARISTATA DC. Daruhalad.

A cold water extract of the stems gave complete mortality of mosquito larvae in 17 hours.--Pendse and coworkers (167).

BERBERIS VULGARIS L.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CAULOPHYLLUM THALICTROIDES (L.) Michx.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. An aqueous extract of the rhizomes was highly toxic to American cockroaches but not to German cockroaches and milkweed bugs. Petroleum ether and chloroform extracts of the rhizomes were toxic to black carpet beetle larvae only.--Heal and coworkers (93).

JEFFERSONIA DIPHYLLA (L.) Pers.

An aqueous extract of the roots and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MAHONIA AQUIFOLIUM (Pursh)Nutt. Synonym: Berberis aquifolium.

An aqueous extract of the roots was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

MAHONIA TRIFOLIATA (Moric.) Fedde. Synonym: Berberis trifoliata.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PODOPHYLLUM PELTATUM L. Mandrake.

An acetone extract of the roots was nontoxic to mosquito larvae.--Hartzell (90).

An aqueous extract of the fresh leaves was nontoxic to American cockroaches. Alcohol, petroleum ether, and chloroform extracts of the leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* mosquito. An aqueous extract of the fresh rhizomes was very toxic to American cockroaches when injected into the blood stream. Alcohol, petroleum ether, and chloroform extracts of the rhizomes were toxic only to black carpet beetle larvae. An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BETULACEAE

ALNUS FIRMA Sieb. & Zucc. Synonym: A. sieboldiana

Water suspensions of the leaves and of the flowers were nontoxic to *Drosophila hydei* larvae, but a suspension of the roots was toxic to these larvae.--Yamaguchi and coworkers (233).

ALNUS TINCTORIA var. OBTUSILOBA Call.

Water suspensions of the leaves and of the fruits and stems were nontoxic to *Drosophila hydei* larvae, but a suspension of the leaves and stems was very toxic to these larvae.--Yamaguchi and coworkers (233).

BETULA ALBA L. White birch.

An aqueous extract of the roots was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

BETULA LENTA L. Birch

An acetone extract of the bark was nontoxic to mosquito larvae.--Hartzell (90).

BETULA LUTEA Michx. Yellow birch.

The wood is very susceptible to termites.--Wolcott (225).

BETULA MANDSCHURICA var. SZECHUANICA (Schneid.) Rehd. Synonym: B. tauschii.

Several fractions of the dry-distillation of the bark were toxic to *Culex pipiens* larvae.--Yamaguchi and coworkers (231).

The dry-distilled bark oil, alone or mixed with other insecticides and an emulsifying agent, is used as an insecticide.--Yamaguchi and coworkers (230).

BETULA PENDULA Roth. Synonym: B. verrucosa.

The powdered plant was nontoxic to *Ixodes* and *Dermacentor* ticks, bedbugs, house flies, *Aedes* and *Anopheles* mosquitoes, and *Drosophila*.--Olenev (163).

BETULA SOLLENNIS Koidz.

A water suspension of the leaves was very toxic to *Drosophila hydei* larvae.--Yamaguchi and coworkers (233).

BIGNONIACEAE

BIGNONIA CAPREOLATA L.

An aqueous extract of the stems and leaves was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

CAMPSIS RADICANS (L.) Seem. Synonym: Bignonia radicans.

An aqueous extract of the whole plant was nontoxic to American cockroaches.--Heal and coworkers (93).

CATALPA BIGNONIOIDES Walt.

An aqueous extract of the leaves was nontoxic to American and German cockroaches.--Heal and coworkers (93).

CATALPA LONGISSIMA Sims. Haitian oak.

The wood is susceptible to termites.--Wolcott (225).

CRESCENTIA CUJETE L.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform

extracts of the roots were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes. An aqueous extract of the fruits was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

DOLICHANDRONE LUTEA (Benth.) Benth. & Hook.

Aqueous extracts of the roots and of the stem bark were nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

DOLICHANDRONE SPATHACEA (L.f.) K. Schum.

JACARANDA BRASILIANA Pers.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

JACARANDA FILICIFOLIA (Anders.) D. Don.

Some of the plant parts, as dusts or extracts, were toxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

MELLOA POPULIFOLIA Bur.

Aqueous extracts of the leaves and of the roots were nontoxic to German and American cockroaches.--Heal and coworkers (93).

NEWBOULDIA LAEVIS Seem.

An aqueous extract of the roots was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

PYROSTEGIA VENUSTA Miers. Synonym: Bignonia venusta.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SPATHODEA CAMPANULATA Beauv.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TABEBUIA BARBATA (E. Mey.) Sandw.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TABEBUIA CAPITATA (Bur. & K. Schum.) Sandw.

The wood is quite resistant to termite attack.--Wolcott (224).

TABEBUIA IPE (Mart.) Standl.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

TABEBUIA PALLIDA Miers. West Indian boxwood.

The wood is very susceptible to termites.--Wolcott (225).

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

TABEBUIA PENTAPHYLLA Hemsl. Roble.

The wood is susceptible to termites.--Wolcott (224).

TABEBUIA sp. Bethberra.

The powdered wood was ineffective against southern armyworms.--Jacobson (108).

TECOMA CONSPICUA DC.

The wood is resistant to termites.--Wolcott (225).

TECOMA STANS var. ANGUSTATA Rehd.

An aqueous extract of the branches and leaves was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

TECOMARIA CAPENSIS (Thunb.) Spack. Synonym: Tecoma capensis.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

BIXACEAE

BIXA ORELLANA L. Anatto.

The fresh ground fruit pulp is applied to the skin as a paint in El Salvador to act as a repellant.--Wellman and van Severen (221).

BOMBACACEAE

BOMBACOPSIS QUINATA (Jacq.) Dugand. Pochote, cedro espino.

The wood is susceptible to termites.--Wolcott (226).

BOMBACOPSIS SEPIUM Pittier.

An aqueous extract of the wood was nontoxic to American and German cockroaches. An alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and *Aedes* mosquito.--Heal and coworkers (93).

CEIBA PENTANDRA (L.) Gaertn. Synonym: *Eriodendron anfractuosum*.

Aqueous extracts of the branches and of the roots were very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol, petroleum ether, and chloroform extracts of each part were nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and *Aedes* mosquito.--Heal and coworkers (93).

OCHROMA PYRAMIDALE (Cav.) Urban. Balsa.

The wood is very susceptible to termites.--Wolcott (225).

OCHROMA sp.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BORAGINACEAE

AMSINCKIA INTERMEDIA Fisch. & Mey.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and *Aedes* and *Anopheles* mosquitoes. An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs. Petroleum ether extracts of the seeds were toxic to black carpet beetle larvae only, while alcohol and chloroform extracts of the seeds were nontoxic to all these species.--Heal and coworkers (93).

ANCHUSA OFFICINALIS L. Anchusa.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

ANCHUSA sp.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ANTIOTREMA DUNNIANUM Hand-Mazz.

The plant showed little toxicity to silkworm and Mexican bean beetle larvae and bean aphids.--Lee and Hansberry (129).

BOURRERIA SUCCULENTA Jacq.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CORDIA ALLIODORA Cham. Synonym: *Cerdana alliodora*. Spanish elm.

The wood is resistant to termites.--Wolcott (225).

The heartwood of this tree from Costa Rica was very resistant to termites.--Scheffer and Duncan (191).

CORDIA CYLINDRISTACHYA Roem. & Schult.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CORDIA GOELDIANA Huber. Brazilian walnut.

The wood is susceptible to termites.--Wolcott (225)

CORDIA GRAVEOLENS H. B. K.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CRYPTANTHA BARBIGERA (Gray) Greene.

CRYPTANTHA sp.

Aqueous extracts of the stems, leaves, and flowers of C. barbigera and of the roots of C. sp. were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

CYNOGLOSSUM OFFICINALE L.

An aqueous extract of the roots was very toxic to American but not to German cockroaches. A chloroform extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

ECHIUM PLANTAGINEUM L.

ECHIUM VULGARE L.

Aqueous extracts of the roots of each species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HACKELIA FLORIBUNDA (Lehm.) I. M. Johnst. Synonym: Echinospermum floribundum.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HACKELIA JESSICAE (McGregor) Brand. Synonym: Lappula jessicae.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HELIOTROPIUM CONVOLVULACEUM (Nutt.) Gray.

HELIOTROPIUM GREGGII Torr.

An aqueous extract of the upper parts and the flowers was nontoxic to German and American cockroaches.--Heal and coworkers (93).

HELIOTROPIUM EROSUM var. PROSTRATUM.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HELIOTROPIUM INDICUM L. Fedegoso.

The dried leaves, stalks, roots, and seed racemes are highly attractive to several species of moths, butterflies, wasps, beetles, grasshoppers, bugs, mosquitoes, and flies.--Moss (153).

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LITHOSPERMUM LINEARIFOLIUM Goldie.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MERTENSIA LANCEOLATA DC.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether and chloroform extracts of the roots were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquito. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

MERTENSIA VIRGINICA (L.) Link.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SYMPHYTUM OFFICINALE L.

An aqueous extract of the aerial parts was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TOURNEFORTIA GNAPHALODES (L.) R. Br. Synonym: Mallotonia gnaphalodes.

An aqueous extract of the stems and roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An extract of the branches and roots was nontoxic to all these insects.--Heal and coworkers (93).

TOURNEFORTIA HIRSUTISSIMA L.

An aqueous extract of the leaves was nontoxic to German and American cockroaches. A chloroform extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and petroleum ether extracts were nontoxic to all these insects. An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

TOURNEFORTIA VOLUBILIS L.

Alcohol, petroleum ether, and chloroform extracts of the whole plant were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An aqueous extract of the stems and flowers was nontoxic to all these insects.--Heal and coworkers (93).

TRICHODESMA ZEYLANICUM R. Br.

An aqueous extract of the stems, leaves, and fruits was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BROMELIACEAE

ANANAS COMOSUS (L.) Merr.

An aqueous extract of the whole plant was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

BROMELIA KARATAS L.

An aqueous extract of the infrutescence was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes. An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TILLANDSIA FASCICULATA Sw.

TILLANDSIA RECURVATA L.

Aqueous extracts of the stems and leaves of each species were toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extracts.--Heal and coworkers (93).

TILLANDSIA USNEOIDES L.

An aqueous extract of the whole plant was nontoxic to American and German cockroaches.--Heal and coworkers (93).

BURSERACEAE

BOSWELLIA CARTERII Birdw. Frankincense, olibanum tears.

Acetone and water extracts of the whole plant were nontoxic to mosquito larvae.--Hartzell (89).

BURSERA GRAVEOLENS Triana & Planch.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BURSERA GUMMIFERA L. West Indian birch, almacigo.

The wood is very susceptible to termites.--Wolcott (225).

BURSERA MICROPHYLLA Gray. Synonym: Elaphrium microphyllum.

An aqueous extract of the bark was nontoxic to American cockroaches. An aqueous extract of the gum was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BURSERA sp.

An aqueous extract of the stems and fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CANARIUM COMMUNE L.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COMMIPHORA AFRICANA (Arn.) Engl.

Aqueous extracts of the branches and of the stem bark were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COMMIPHORA MYRRHA (T. Nees) Engl. Myrrh.

Acetone and water extracts of myrrh gum were nontoxic to mosquito larvae.--Hartzell (89).

DACRYODES EXCELSA Vahl. Candlewood.

The wood is very susceptible to termites.--Wolcott (225).

An alcohol extract of the resin was somewhat toxic to black carpet beetle larvae, but nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

DACRYODES HEXANDRA Griseb.

An aqueous extract of the stem wood, branches, and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the whole plant were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

PACHYLOBUS EDULIS G. Don. Synonym: Canarium edule.

An aqueous extract of the stem bark was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PROTIUM DECANDRUM March.

The wood is very susceptible to termites.--Wolcott (225).

PROTIUM HEPTAPHYLLUM (Aubl.) March. Synonym: Icica tacamahaca.

The wood is resistant to termites.--Wolcott (225).

PROTIUM sp. Anyme.

The essential oil did not repel Aedes mosquitoes.--McCulloch and Waterhouse (142).

An aqueous extract of the resin was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TETRAGASTRIS BALSAMIFERA (Sw.) Kuntze. Copal, almacey.

The wood is susceptible to termites.--Wolcott (225).

TETRAGASTRIS CATUABA Soares da Cunha.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TETRAGASTRIS sp.

An aqueous extract of the bark and branches was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

BUXACEAE

BUXUS JAPONICA Muell. Arg.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

BUXUS SEMPERVIRENS L.

An aqueous extract of the branchlets and leaves was nontoxic to American cockroaches.--Heal and coworkers (93).

PACHYSANDRA PROCUMBENS Michx.

PACHYSANDRA TERMINALIS Sieb. & Zucc.

Aqueous extracts of the whole plant of P. procumbens and of the stems and leaves of P. terminalis were nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

SIMMONDSIA CHINENSIS (Link) Schneid. Synonym: S. californica.

Aqueous extracts of the branchlets and leaves, of the fruits, and roots were all nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

CACTACEAE

ARIOCARPUS FISSURATUS (Engelm.) K. Schum.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CEREUS DIGUETII Weber. Synonym: Wilcoxia striata.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LOPHOPHORA WILLIAMSII (Lem.) Coult.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MACHAEROCEREUS ERUCA (Brandeg.) Britton & Rose.

An aqueous extract of the whole fresh plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

MACHAEROCEREUS GUMMOSUS (Engelm.) Britton & Rose.

An aqueous extract of the stems showed some toxicity to American and German cockroaches. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

PACHYCEREUS MARGINATUS (DC.) Britton & Rose.

An aqueous extract of the stems was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PENIOCEREUS GREGGII (Engelm.) Britton & Rose.

An aqueous extract of the tubers was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

RHIPSALIS CASSUTHA Gaertn.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RHIPSALIS LEUCORHAPHIS K. Schum.

An aqueous extract of the stems was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A petroleum ether extract was somewhat toxic to German cockroaches, milkweed bugs, and black carpet beetles, but not to webbing clothes moth larvae. Alcohol and chloroform extracts were nontoxic to all these insects as well as to Aedes mosquito larvae and confused flour beetles.--Heal and coworkers (93).

SELENICEREUS GRANDIFLORUS (L.) Britton & Rose.

An aqueous extract of the stems was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CALYCANTHACEAE

CALYCANTHUS FERTILIS Walt.

An aqueous extract of the branches and leaves was nontoxic to American and German cockroaches.--Heal and coworkers (93).

CAMPANULACEAE

CAMPANULA PETIOLATA A. DC.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CANELLACEAE

CANELLA WINTERANA (L.) Gaertn. Wild cinnamon, canela.

An acetone extract of the bark was nontoxic to mosquito larvae.--Hartzell (90).

The bark was appreciably toxic to adults of Andrector ruficornis when dusted on bean leaves but was inert as a contact insecticide. It was also ineffective against melonworm, fall armyworm, and diamondback moth larvae, cotton stainer adults, and Australian cockroach nymphs. The powdered wood was ineffective against all these insects.--Plank (174).

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CANNACEAE

CANNA EDULIS Ker.

An aqueous extract of the rhizomes was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CANNA FLACCIDA Rosc.

An aqueous extract of the whole plant was toxic to German and American cockroaches but not to milkweed bugs. Alcohol and petroleum ether extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

CAPPARIDACEAE

ATAMISQUEA EMARGINATA Miers.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CAPPARIS CORDIFOLIA Lam.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CAPPARIS FLEXUOSA L. Mosto.

The fruits of this Venezuelan shrub may be used as an insect repellent.--Grünwald (79).

An aqueous extract of the stem bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CAPPARIS HORRIDA L. f.

CAPPARIS MICRACANTHA DC.

CAPPARIS PORTORICENSIS Urban.

CAPPARIS TWEEDIANA Eichl.

CAPPARIS sp.

Aqueous extracts of the roots of C. horrida and C. tweediana, the stem bark of C. micracantha, the roots and bark of C. portoricensis, and the root bark of C. sp. were all nontoxic to German and American cockroaches.--Heal and coworkers (93).

CLEOME ANOMALA H. B. K.

CLEOME GYNANDRA L.

Aqueous extracts of the roots of these species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CLEOME PRURIENS Planch. & Triana.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CLEOME PSORALEAEFOLIA DC.

Some parts of this species, as dusts or extracts, were toxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CLEOME SERRULATA Pursh.

Aqueous extracts of the roots, the capsules and seeds, and the fruits were all nontoxic to German and American cock-

roaches and milkweed bugs.--Heal and coworkers (93).

CLEOME SPINOSA Jacq.

Some parts of this species, as dusts or extracts, were toxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CLEOMELLA PLOCASPERMA S. Wats.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GYNANDROPSIS LEHMANNI Hieron.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

GYNANDROPSIS PENTAPHYLLA (L.) DC.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ISOMERIS ARBOREA Nutt.

An aqueous extract of the roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

MAERUA ANGOLENSIS DC.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

WISLIZENIA REFRACTA Engelm.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CAPRIFOLIACEAE

DIERVILLA LONICERA Mill.

An aqueous extract of the branchlets and bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

LONICERA XYLOSTEUM L.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SAMBUCUS CANADENSIS L. Elder.

An aqueous extract of the fruits and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

Water suspensions of the leaves and of the combined leaves and stems were nontoxic to Drosophila hydei larvae, but a suspension of the roots was toxic to these larvae.--Yamaguchi and coworkers (233).

SAMBUCUS COERULEA Raf.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SAMBUCUS NIGRA L. European elder.

An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

The volatile substances in this plant active against insects and lower forms o[f] life, were found to contain hydrogen cyanide, which is probably the active component.--Drabkin (56).

SAMBUCUS PUBENS Michx.

An aqueous extract of the leaves wa[s] very toxic to American cookroaches whe[n] injected into the blood stream, but Germa[n] cockroaches and milkweed bugs were un[-]affected after immersion in the extrac[t]. Alcohol, petroleum ether, and chlorofor[m] extracts of the leaves were somewhat toxi[c] to black carpet beetle larvae, but not t[o] German cockroaches, milkweed bugs, a[nd] larvae of the webbing clothes moth a[nd] Aedes and Anopheles mosquitoes. A

aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SAMBUCUS sp.

Water and acetone extracts of the flowers of S. canadensis or S. nigra were nontoxic to mosquito larvae.--Hartzell (89).

An acetone extract of the roots was toxic to mosquito larvae.--Hartzell (90).

SYMPHORICARPOS ALBUS (L.) Blake.

An aqueous extract of the stems and roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

VIBURNUM NUDUM L.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CARICACEAE

CARICA PAPAYA L. Synonym: Papaya vulgaris. Papaya.

An ointment prepared from the latex is used in El Salvador against chiggers, pubic lice, and toe-burrowing jiggers.--Wellman and van Severen (221).

CARYOCARACEAE

CARYOCAR GLABRUM Pers.

CARYOCAR sp.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CARYOCAR VILLOSUM Pers. Brazilian butternut.

The wood is resistant to termites.--Wolcott (225).

CARYOPHYLLACEAE

AGROSTEMMA GITHAGO L.

An aqueous extract of the flowers was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ARENARIA PEPLOIDES L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ARENARIA LEPTOCLADOS Guss.

A water suspension of the leaves, stems, and roots was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

DRYMARIA PACHYPHYLLA Woot. & Standl.

An aqueous extract of the whole plant was somewhat toxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts showed some toxicity to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

LYCHNIS CORONARIA (L.) Desr. Dusty miller.

An acetone extract of the whole plant was toxic to mosquito larvae.--Hartzell (90).

LYCHNIS GRACILIMA (Rohrb.) Makino.

A water suspension of the roots was nontoxic to Drosophila hydei larvae, but a suspension of the leaves and stems was highly toxic to these larvae.--Yamaguchi and coworkers (233).

POLYCARPON TETRAPHYLLUM L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SILENE ANTIRRHINA L.

SILENE VIRGINICA L.

Aqueous extracts of these plants were toxic to American cockroaches when in-

jected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

SPERGULA ARVENSIS L.

An aqueous extract of the whole plant with flowers was toxic to milkweed bugs but not to German and American cockroaches.--Heal and coworkers (93).

SPERGULARIA MACROTHECA (Hornem.) Heynh.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SPERGULARIA MARINA (L.) Griseb.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts showed some toxicity to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

STELLARIA MEDIA (L.) Cyrill. Chickweed.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

STIPULICIDA SETACEA Michx.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CASUARINACEAE

CASUARINA EQUISETIFOLIA L. Australian pine, beefwood.

The wood is very susceptible to termites.--Wolcott (225).

An aqueous extract of the branches was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CELASTRACEAE

CELASTRUS ANGULATUS Maxim. Bitter tree, anglestem bittersweet.

The powdered leaves and roots were both nontoxic to bean aphids.--Chiu and coworkers (48).

This plant is used by Chinese farmers for the control of vegetable insects. Pulverized root bark and water suspensions thereof were effective against tent caterpillars as a stomach poison and as a repellent. An acetone extract of the root bark was toxic to the tent caterpillar and slightly toxic to American cockroaches and confused flour beetles. Neither the powdered root bark nor its extract was toxic to cotton aphids. Crystalline and non-crystalline fractions of a petroleum ether extract of the root bark were repellent and toxic to tent caterpillars and willow leaf beetles.--Chiu (47).

The powdered root is effective against the migratory locust and the cruciferous leaf beetle.--Anonymous (12).

The powdered root and root bark were nontoxic to southern armyworms, melonworms, southern beet webworms, bean leaf rollers, and cross-striped cabbage worms, but they were toxic to Hawaiian beet webworms.--Bottger and Jacobson (36).

The powdered roots and root bark were toxic and nontoxic, respectively, to European corn borer larvae, and both were nontoxic to grasshoppers and codling moth larvae.--Jacobson (108).

An aqueous extract of the branches and leaves was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

CELASTRUS ARTICULATUS Thunb. Oriental bittersweet.

The powdered root and root bark were nontoxic to southern armyworms, melonworms, southern beet webworms, bean leaf rollers, cross-striped cabbage worms, and codling moth larvae. The roots were toxic to Hawaiian beet webworms and the root bark was toxic to celery leaf tiers.--Bottger and Jacobson (36).

The powdered roots and root bark were nontoxic to European corn borer larvae, grasshoppers, and screwworm larvae.--Jacobson (108).

CELASTRUS PANICULATUS Willd.

An aqueous extract of the leaves was nontoxic to German and American cock-

roaches and milkweed bugs.--Heal and coworkers (93).

CELASTRUS RUGOSUS Rehd. & Wils.

An acetone extract of the roots was nontoxic to mosquito larvae.--Jacobson (108).

CELASTRUS SCANDENS L. False bittersweet, American bittersweet.

An acetone extract of the bark was nontoxic to mosquito larvae.--Hartzell (90).

The powdered roots and root bark were nontoxic to southern armyworms, melonworms, southern beet webworms, and Hawaiian beet webworms. The powdered seeds and seed pods were nontoxic to southern armyworms, melonworms, Hawaiian beet webworms, bean leaf rollers, and cross-striped cabbage worms.--Bottger and Jacobson (36).

The powdered roots were nontoxic to grasshoppers, but an ether extractive was effective against codling moth larvae. A methanol extractive of the root bark was nontoxic to codling moths and German cockroaches. Powdered seeds and seed pods were nontoxic to European corn borers. An acetone extractive of the seeds and pods showed some effect against codling moth larvae but not against German cockroaches.--Jacobson (108).

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

CELASTRUS sp.

A water suspension of the powdered root was quite toxic to codling moth larvae but had no effect on bean aphids. Alcohol and chloroform extracts had no effect on silkworm larvae, and these extracts, as well as an acetone extract, had no effect on bean aphids.--Lee and Hansberry (129).

ELAEODENDRON ATTENUATUM A. Rich.

Aqueous extracts of the bark, of the branches and leaves, and of the roots were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ELAEODENDRON XYLOCARPUM DC. Nut muscat.

The wood is very susceptible to termites.--Wolcott (225).

An aqueous extract of the stem bark was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts showed some toxicity to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and _Aedes_ and _Anopheles_ mosquitoes.--Heal and coworkers (93).

EUONYMUS ATROPURPUREUS Jacq.

An aqueous extract of the root bark showed some toxicity to American cockroaches but not to German cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and _Aedes_ and _Anopheles_ mosquitoes.--Heal and coworkers (93).

EUONYMUS BUNGEANUS Maxim.

EUONYMUS OBOVATUS Nutt.

EUONYMUS YEDOENSIS Koehne.

Aqueous extracts of the fruits were nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

EUONYMUS EUROPAEUS L. Spindle, louseberry tree.

Alcohol, acetone, or benzene extracts of the fruits showed considerable paralyzing action and mortality when tested at high concentration against adult chrysanthemum aphids, saw-toothed grain beetles, and _Ahasverus advena_.--Tattersfield and coworkers (209).

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts showed some toxicity to webbing clothes moths and black carpet beetles but not to German cockroaches, milkweed bugs, and _Aedes_ and _Anopheles_ mosquito larvae.--Heal and coworkers (93).

EUONYMUS FORTUNEI var. RADICANS (Miq.) Rehd. Synonym: _E. radicans_.

An aqueous extract of the fruits was nontoxic to German and American cockroaches.--Heal and coworkers (93).

EUONYMUS JAPONICUS L. f.

An aqueous extract of the whole plant showed some toxicity to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

EUONYMUS OCCIDENTALIS Nutt.

An aqueous extract of the branchlets and leaves showed some toxicity to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

EUONYMUS sp.

An aqueous extract of the fruits was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

FORSELLESIA NEVADENSIS (Gray)Greene.

An aqueous extract of the branches was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GOUPIA GLABRA Aubl.

The wood is resistant to termites.--Wolcott (225).

Aqueous extracts of the roots and of the stemwood were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GYMINDA LATIFOLIA (Sw.) Urban.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GYMNOSPORIA CASSINOIDES (L' Hér.) Masf. Synonym: Catha cassinoides.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GYMNOSPORIA MONTANA Benth.

An aqueous extract of the roots and bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GYMNOSPORIA SENEGALENSIS Loes.

An aqueous extract of the roots and bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

KOKOONA ZEYLANICA Thwait.

An aqueous extract of the roots was toxic to milkweed bugs but not to German and American cockroaches. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito. An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LOPHOPETALUM TOXICUM Loher.

An aqueous extract of the bark was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

LOPHOPETALUM WIGHTIANUM Arn.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MAYTENUS PHYLLANTHOIDES Benth.

Aqueous extracts of the branchlets and leaves and of the stems were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MORTONIA SCABRELLA Gray.

Petroleum ether, combined ethyl ether and chloroform, and alcohol extractives were all ineffective against codling moth larvae. Petroleum ether and alcohol extractives were toxic to male but not to female German cockroaches.--Jacobson (108).

PACHYSTIMA CANBYI Gray.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PERROTTETIA SANDWICENSIS Gray.

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

RHACOMA CROSSOPETALUM L.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SCHAEFFERIA FRUTESCENS Jacq.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TRIPTERYGIUM FORRESTII Loesener.

When placed on food plants treated with the powdered roots of this plant, silkworm and Mexican bean beetle larvae, bean aphids, spring cankerworms, cabbage loopers, and ugly-nest caterpillars did not feed. The roots showed considerable toxicity to codling moth larvae.--Lee and Hansberry (129).

When plants were dusted with the powdered root bark, only 2 or 3 percent were seriously attacked by the melon leaf beetle. The dust had a strong repellent effect. The aphid population was also reduced by this treatment. The dust was effective against the cabbage flea beetle.--Cheng (43).

The root bark acts as a repellent and as a stomach poison, but its contact action is quite weak. When applied as a dust, it was effective against Chrysomelids and certain species of Lepidopterous larvae.--Chiu and coworkers (48).

The powdered root bark was repellent to the bean plataspid, armyworms, Prodenia litura, cabbage leaf beetles, and cucumber beetles. Alcohol extracts and water suspensions of the root bark were toxic to bean plataspids, sugar-cane wooly aphids, and cruciferous leaf beetles, but nontoxic to the China-grass butterfly and the black cucurbit beetle. An acetone extract was nontoxic to the ten-spotted grape leaf beetle.--Chiu (47).

The root, containing an alkaloid, is used in China as an insecticide to paralyze insects.--Stepaneck and Prien (201).

TRIPTERYGIUM REGELII Sprague & Tak.

The powdered root bark was nontoxic to southern armyworms and southern beet webworms but toxic to Hawaiian beet webworms.--Bottger and Jacobson (36).

The powdered root bark was effective against codling moth larvae.--Jacobson (108).

An aqueous extract of the stems and leaves was nontoxic to American cockroaches. An extract of the stems was nontoxic to German and American cockroaches. An extract of the roots was nontoxic to both species of cockroaches and to milkweed bugs.--Heal and coworkers (93).

TRIPTERYGIUM WILFORDII Hook. f.
Thundergod vine.

Results of insecticidal tests using acetone extracts of the root bark from China were rather uncertain, as the extract was more toxic at 1 percent than at 5 percent against saw-toothed grain beetles. There was no toxic effect on bean aphids or diamondback moth larvae, although some repellency was shown to the latter. Acetone extracts of fresh, undried root bark showed fair toxicity to saw-toothed grain beetles but little or no toxicity to bean aphids and diamondback moth larvae. Acetone extracts of the fresh, undried leaves and stems showed slight contact toxicity to bean aphids. The powdered root bark, used as a dust, was appreciably toxic to diamondback moth larvae.--Tattersfield and coworkers (209).

Crystalline and noncrystalline alkaloid mixtures isolated from the root bark were highly toxic to codling moth larvae.--Acree and Haller (1).

The powdered root was toxic to celery leaf tiers and cross-striped cabbage worms but not to armyworms, pea aphids, two-spotted spider mites, and Autographa 00.--Bottger and Jacobson (36).

The alkaloidal mixture, wilfordine, isolated from both old and fresh root, was toxic to newly hatched European corn borer larvae.--Beroza (32).

The powdered small roots were toxic to codling moths, diamondback moths, imported cabbage worms, and American cockroaches, but large roots were nontoxic to American cockroaches. The root powder was also toxic to European corn borer larvae and Mexican bean beetles, slightly toxic to tomato fruitworms, adult pea aphids, and melonworms, and nontoxic to screwworms, pea weevils, southern armyworms, and southern beet webworms. Extracts of

the roots were toxic to larvae which attack Cruciferae, and to codling moths, but nontoxic to wireworms.--Jacobson (108).

The ester alkaloids wilforine, wilfordine, wilforgine, and wilfortrine were all effective against European corn borer larvae.--Beroza (33).

Wilforzine was much less toxic to diamondback moth larvae than wilforine.--Beroza (34).

CERATOPHYLLACEAE

CERATOPHYLLUM DEMERSUM L.

Aqueous extracts of the stems and leaves and of the whole plant were highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

CERCIDIPHYLLACEAE

CERCIDIPHYLLUM JAPONICUM Sieb. & Zucc.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHENOPODIACEAE

ALLENROLFEA OCCIDENTALIS (S. Wats.) Kuntze.

An aqueous extract of the stems and leaves was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were somewhat toxic to larvae of the webbing clothes moth and black carpet beetle, but they were nontoxic to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae. An aqueous extract of the upper parts was very toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ALLENROLFEA sp.

An aqueous extract of the branchlets was highly toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ANABASIS APHYLLA L.

Smearing 5-10 percent solutions of anabasine sulfate on the body did not repel malaria mosquitoes but did protect against their bites. Aqueous solutions of 1-3 percent strength were completely ineffective.--Nabokov (155).

The dried stems are powdered, steeped in water, and treated with plant ash, or with soda ash or potash solution. The mixture is dried, powdered, and screened for use as an insecticide.--Ignat'ev (103).

Bentonite dust containing about 5 percent adsorbed anabasine was a very potent contact poison against agricultural pests.--Rabinovich and Konovalova (180).

ATRIPLEX CANESCENS James

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ATRIPLEX NUTTALLII S. Wats.

An aqueous extract of the tops and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

AXYRIS AMARANTHOIDES L.

An aqueous extract of the upper parts was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were somewhat toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

BOUSSINGAULTIA sp.

An aqueous extract of the tubers was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CHENOPODIUM ALBUM L.

An aqueous extract of the whole plant was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

CHENOPODIUM AMBROSIOIDES L. Synonyms: C. anthelminticum, C. ambrosioides anthelminticum. American wormseed.

Some parts of the plant were toxic as dusts or extracts to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

The powdered plant was nontoxic to southern beet webworms and European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the plant were ineffective against house flies and codling moths.--Jacobson (108).

An aqueous extract of the seeds was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the seeds were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes. An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs. Aqueous extracts of the stems and roots, and of the whole plant were toxic to American cockroaches but not to German cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts of the whole plant were somewhat toxic to black carpet beetle larvae, but were nontoxic to all the other insect species mentioned.--Heal and coworkers (93).

The essential oil is freed of ascaridole and mixed with diethyl phthalate to prepare an insect repellent.--Honno and coworkers (96).

CHENOPODIUM MULTIFIDUM L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CORISPERMUM HYSSOPIFOLIUM L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CYCLOLOMA ATRIPLICIFOLIUM (Spreng.) Coult.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GRAYIA SPINOSA (Hook.) Moq.

An aqueous extract of the branches was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HALOGETON GLOMERATUS (M. Bieb.) C. A. Mey.

An aqueous extract of the whole plant was toxic to German and American cockroaches but not to milkweed bugs. Alcohol, petroleum ether, and chloroform extracts showed some toxicity to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

HALOGETON sp.

The powdered whole plant, tested as a dust, was ineffective against armyworms, pea aphids, two-spotted spider mites, and large milkweed bugs.--Jacobson (108).

HALOXYLON AMMODENDRON Bunge. Sacsaul.

Mange in sheep was controlled by dusting with a mixture of 90 parts sieved ash of sacsaul, 8 parts ground naphthalene, and 2 parts flowers of sulfur.--Lagereva (126).

KOCHIA LITTOREA Makino.

A water suspension of the leaves, stems, and roots was slightly toxic to Drosophila hydei larvae, but a suspension of the leaves and stems showed greater toxicity to these larvae.--Yamaguchi and coworkers (233).

KOCHIA VESTITA S. Wats.

An aqueous extract of the whole plant was somewhat toxic to German cockroaches,

but it was nontoxic to American cockroaches and milkweed bugs.--Heal and coworkers (93).

KOCHIA sp.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the bloodstream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MONOLEPIS NUTTALLIANA (Roem. & Schult.) Greene.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

NITROPHILA OCCIDENTALIS S. Wats.

An aqueous extract of the stems, leaves, and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SALICORNIA AMBIGUA Michx.

SALICORNIA RUBRA A. Nels.

Aqueous extracts of these species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SALSOLA KALI L.

SALSOLA KALI var. TENUIFOLIA Tausch. Synonym: S. pestifer.

Aqueous extracts of these plants were somewhat toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SARCOBATUS BAILEYI Coville.

An aqueous extract of the branches was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SARCOBATUS VERMICULATUS (Hook.) Torr.

An aqueous extract of the tops and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

THRELKELDIA PROCERIFLORA.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHLORANTHACEAE

HEDYOSMUM ARBORESCENS Sw.

Aqueous extracts of the branches and of the branchlets and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CISTACEAE

HELIANTHEMUM CORYMBOSUM Michx.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CLETHRACEAE

CLETHRA ACUMINATA Michx.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CLUSIACEAE

CLUSIA FLAVA Jacq.

An aqueous extract of the roots and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CLUSIA MINOR L.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches and milkweed bugs. Alcohol and petroleum ether extracts were nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

CLUSIA ROSEA Jacq. Strangling fig, Scotch lawyer.

The wood is very susceptible to termites.--Wolcott (225).

The powdered leaves, bark, wood, and roots each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

Aqueous extracts of the young fruits, of the gum from these fruits, and of the bark were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MAMMEA AMERICANA L. Mamey.

The powdered mature seeds were very toxic to fall armyworms, melonworms, diamondback moths, Cerotoma ruficornis, Myzus persicae, Macrosiphum sonchi, and Ascia monuste. A kerosene extract of the seeds was toxic to American and German cockroaches, flies, ants, and mosquitoes. The seed bulbs and immature fruits were nontoxic to several species of insects. The powdered bark was toxic to melonworms and diamondback moths but not to fall armyworms or Cerotoma ruficornis. The powdered leaves were toxic to melonworms, fall armyworms, and diamondback moths, but not to Cerotoma ruficornis.--Plank (173).

The dried pulp of the seeds was highly toxic, as a water suspension, to the larvae of various species of mosquitoes. On exposure to light and air, the suspension retained its toxicity for 3 to 4 days.--Flock and de Lajudie (65, 66).

The wood is very susceptible to termites.--Wolcott (225).

The active principle in the mature seeds, the most toxic part of the plant, was found to be mameyin, a type of substance somewhat similar in composition and effect to pyrethrins. Mameyin comprised 0.19 percent of the weight of the seed.--Jones and Plank (112).

The ground seeds are used as a paste and a water suspension in El Salvador against poultry lice, mites, and head lice.--Wellman and van Severen (221).

The powdered seed was ineffective against several Coleoptera.--Flock (63).

The powdered green and ripe fruit, leaves, roots, seeds, and stems were all nontoxic to southern armyworms. The ripe fruit, leaves, roots, seeds, and stems were nontoxic to cross-striped cabbage worms, but the powdered seeds were highly toxic to imported cabbage worms. The leaves, roots, and stems were nontoxic to celery leaf tiers. Petroleum ether, acetone, and alcohol extracts of all parts except the stems were toxic to mosquito larvae but not as toxic to house flies. The petroleum ether extract of the stems was toxic to mosquito larvae and slightly toxic to house flies.--Sievers and coworkers (197).

When used against fleas and ticks on dogs, an infusion of one pound of the half-ripe fruits in one gallon of water was as effective, but not as permanent, as a 1-percent suspension of DDT.--Plank (175).

The powdered seeds were toxic to southern armyworms, melonworms, southern beet webworms, and variegated cutworms, but not to large milkweed bugs.--Bottger and Jacobson (36).

The powdered seeds and a petroleum ether extractive thereof were nontoxic to European corn borers. The petroleum ether extractive was very toxic to southern armyworms, melonworms, southern beet webworms, codling moth larvae, and adult house flies, but it had no effect on adult Aedes mosquitoes. Combined ethyl ether, chloroform, and alcohol extractives of the petroleum ether-extracted seeds had no effect on codling moth larvae and house flies.--Jacobson (108).

An infusion of the half-ripe fruits at one pound per gallon of water was highly toxic to melonworm larvae both as a stomach and a contact poison. It also gave 100 percent control of Andrector ruficornis adults by contact but was nontoxic to this insect as a stomach poison. This infusion and the dried powdered seeds gave complete mortality of the fleas Ctenocephalides felis and Pulex irritans in one-half hour. When applied to dogs infested with these species of fleas and with the brown dog tick, both materials acted faster than a 1-percent suspension of DDT in water. The leaves have been used for many years in Puerto Rico as a wrapping around the trunk of newly set garden plants to prevent the attack of garden insects at or just below the ground. The powdered leaves were very effective as a stomach poison against melonworms, fall armyworms, and diamondback moth larvae, but had no effect on Andrector ruficornis adults or adult rice weevils. The leaves were ineffective, as a contact poison, against diamondback moth larvae and cotton stainer adults. The flowers were toxic to melonworm larvae both as a stomach poison and as a contact poison, but they were ineffective against diamondback moth larvae,

Andrector ruficornis adults, cotton stainer adults, and Australian cockroach nymphs.

The immature fruits showed some toxicity to melonworm and diamondback moth larvae, but were inert to fall armyworms, Andrector ruficornis, cotton stainer and rice weevil adults, and American cockroach nymphs. The powdered seed bulbs had no effect on melonworms, fall armyworms, southern beet webworms, diamondback moths, Brenthia pavonacella larvae, Andrector ruficornis and rice weevil adults, and American cockroach nymphs. The mature seeds were highly toxic both as a stomach and a contact poison to melonworms, fall armyworms, diamondback moths, Andrector ruficornis, rice weevils, and Diabrotica bivittata. As a contact poison, the mature seeds had some toxicity to Australian cockroach nymphs, but were ineffective against cotton stainer adults and American cockroach nymphs. As a stomach poison, the twig bark was fairly toxic to melonworm and diamondback moth larvae, but ineffective against fall armyworms, southern beet webworms, Brenthia pavonacella, and Andrector ruficornis. As a contact poison, the twig bark was ineffective against diamondback moth larvae, cotton stainer adults, and American cockroach nymphs. The limb bark had some toxicity to melonworm larvae in contrast to the limb wood, while both of these parts were inert to Andrector ruficornis and cotton stainer adults, and Australian cockroach nymphs. As a stomach poison, the roots were quite toxic to melonworm and diamondback moth larvae, and Andrector ruficornis adults. As a contact poison, the roots showed some toxicity to melonworm larvae but were inert to Andrector and cotton stainer adults and to Australian cockroach nymphs.--Plank (174).

An aqueous extract of the bark and leaves was toxic to milkweed bugs but not to German and American cockroaches. An extract of the branchlets and leaves was nontoxic to all of these species. An extract of the fruits was highly toxic to American cockroaches and milkweed bugs, but not to German cockroaches. Extracts of the shells of the fruit, of the bark, wood, roots, and leaves, and of the seed gum were nontoxic to these insects. Alcohol and petroleum ether extracts of the stems and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. The chloroform extract of the stems and leaves was nontoxic to all these insects. A petroleum ether extract of the fruits was toxic to milkweed bugs, webbing clothes moths, and black carpet beetles, but not to German cockroaches and Anopheles mosquito larvae. Alcohol and chloroform extracts of the fruit were toxic only to black carpet beetle larvae. Alcohol, petroleum ether, and chloroform extracts of the leaves were toxic only to black carpet beetle larvae. A petroleum ether extract of the roots was toxic to milkweed bugs, webbing clothes moths, black carpet beetles, and Anopheles mosquito larvae, but not to German cockroaches. Alcohol, petroleum ether, and chloroform extracts of the wood were toxic only to black carpet beetle larvae. A petroleum ether extract of the bark was toxic only to webbing clothes moth and black carpet beetle larvae.--Heal and coworkers (93).

CNEORACEAE

CNEORUM PULVERULENTUM Vent.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COCHLOSPERMACEAE

AMOREUXIA WRIGHTII Gray.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. The petroleum ether extract of the roots was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts were nontoxic to Aedes mosquito larvae as well as all the other insect species tested.--Heal and coworkers (93).

COCHLOSPERMUM VITIFOLIUM Willd.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the roots was toxic only to American cockroaches.--Heal and coworkers (93).

COMBRETACEAE

BUCHENAVIA CAPITATA Eichl. Synonym: Terminalia hilariana. Yellow saunders.

The wood is resistant to termites.--Wolcott (225).

COMBRETUM CAOUCIA (Aubl.) Exell.

An aqueous extract of the fruits was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A petroleum ether extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts were nontoxic to these insects as well as Aedes mosquito larvae.--Heal and coworkers (93).

COMBRETUM PACHYCLADUM Baker.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GUIERA SENEGALENSIS Lam.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An extract of the roots was nontoxic to all these species.--Heal and coworkers (93).

LAGUNCULARIA RACEMOSA Gaertn. f. Mangrove.

The wood is resistant to termites.--Wolcott (225).

QUISQUALIS INDICA L.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TERMINALIA AMAZONIA (Gmel.) Exell. Amarillo.

The wood is resistant to termites.--Wolcott (226).

TERMINALIA CATAPPA L. West Indian almond.

The wood is very susceptible to termites.--Wolcott (225).

An acetone extract of almond meal was nontoxic to mosquito larvae.--Hartzell (90).

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TERMINALIA TOMENTOSA Mart.

An aqueous extract of the fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

COMMELINACEAE

ATHYROCARPUS PERSICARIAEFOLIUS Hemsl.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

COMMELINA ELEGANS H. B. K.

The powdered leaves and stems showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

RHOEO DISCOLOR (L. Her.) Hance.

An aqueous extract of the stems and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TRADESCANTIA MULTIFLORA Sw.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TRADESCANTIA ROSEA Vent. Synonym: Cuthbertia rosea.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ZEBRINA PENDULA Schnizl. Wandering Jew.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

COMPOSITAE

ACANTHOSPERMUM AUSTRALE (Loefl.) Kuntze.

An aqueous extract of the whole plant was toxic to American cockroaches when

injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ACHILLEA LANULOSA Nutt.

An aqueous extract of the upper parts and flowers was slightly toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

ACHILLEA MICRANTHA Willd.

The flowers are used in Asia Minor as an insecticide.--Berk (31).

ACHILLEA MILLEFOLIUM L. Yarrow.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

An aqueous extract of the tops and lower parts of the plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ACHILLEA SIBIRICA var. PTARMICOIDES.

A water suspension of the leaves, stems, and flowers was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

ADENOCAULON BICOLOR Hook.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AGERATUM CONYZOIDES L.

An aqueous extract of the stems, leaves, and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

AGOSERIS GLAUCA var. PARVIFLORA (Nutt.) Rydb.

An aqueous extract of the whole plant with flowers was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AGOSERIS GLAUCA var. VILLOSA (Rydb.) Wittr.

An aqueous extract of the roots and leaves was very toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

AMBLYOLEPIS SETIGERA DC.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

AMBROSIA APTERA DC. Bloodweed.

The powdered whole plant had no effect on southern beet webworms and European corn borers. The combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were ineffective against codling moth larvae and house flies.--Jacobson (108).

AMBROSIA CUMANENSIS H. B. K.

Some parts of the plant were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AMBROSIA PSILOSTACHYA DC. Synonym: A. coronopifolia.

The powdered whole plant had no effect on southern beet webworms and European corn borers. The combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were ineffective against codling moth larvae and house flies.--Jacobson (108).

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

ANACYCLUS PYRETHRUM DC. Pellitory.

The powdered root was toxic to armyworms and pea aphids but not to celery leaf tiers and two-spotted spider mites.--Bottger and Jacobson (36).

The powdered root was nontoxic to European corn borers. A petroleum ether extractive was toxic to house flies, but ethyl ether and alcohol extractives of the petroleum ether-extracted root were nontoxic to this insect. The alcohol extractive was worthless against cat fleas, lone star ticks, chiggers, body lice, and as a body louse ovicide, but it showed some toxicity to Anopheles mosquito larvae.--Jacobson (108).

Pellitorine, an amide isolated from the petroleum ether extractive of the roots, was toxic to house flies.--Jacobson (106).

Crude pellitorine was toxic to adult house flies and to Tenebrio molitor. The roots also probably contain another compound toxic to T. molitor.--Crombie (52).

ANAPHALIS MARGARITACEA (L.) Gray.

An aqueous extract of the tops, leaves, and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ANTENNARIA MICROPHYLLA Rydb.

An aqueous extract of the whole plant with flowers was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. --Heal and coworkers (93).

ANTHEMIS ARVENSIS L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

ANTHEMIS COTULA L. Mayweed.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

Alcohol, benzene, or acetone extracts of the whole plant showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

An aqueous extract of the stems was nontoxic to American cockroaches. An alcohol extract of the stems and leaves was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

ANTHEMIS MIXTA L.

An aqueous extract of the flower heads was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

APLOPAPPUS ACRADENIUS (Greene) Blake.

An aqueous extract of the tops and flowers was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

APLOPAPPUS ARMERIOIDES (Nutt.) Gray.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

APLOPAPPUS CILIATUS (Nutt.). Synonym: Prionopsis ciliata.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

APLOPAPPUS EROCOIDES DC.

An aqueous extract of the upper parts was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

APLOPAPPUS NANUS DC. Eaton.

An aqueous extract of the branches and leaves was toxic to German cockroaches but not to American cockroaches and milkweed bugs. A petroleum ether extract of the stems and leaves was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes mosquito. The alcohol extract was nontoxic to all these species.--Heal and coworkers (93).

APLOPAPPUS NUTTALLII Torr. & Gray.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs. --Heal and coworkers (93).

APLOPAPPUS PALMERI Gray.

An aqueous extract of the stems, leaves, and flowers was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

APLOPAPPUS SPINULOSUS (Pursh.) DC.
Synonym: Sideranthus spinulosus.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ARNICA FULGENS Pursh.

An aqueous extract of the flower heads was nontoxic to American cockroaches.--Heal and coworkers (93).

ARNICA MONTANA L.

Water and acetone extracts of the flowers were nontoxic to mosquito larvae.--Hartzell (89).

Acetone extracts of the leaves and of the roots were nontoxic to mosquito larvae.--Hartzell (90).

ARNICA sp.

Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the flower heads were nontoxic to house flies.--Jacobson (108).

Alcohol and chloroform extracts of a plant known as "Arnica do Campo" were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquito. A petroleum ether extract was nontoxic to all these species. An aqueous extract of the branches, leaves, and flowers was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ARTEMISIA ABROTANUM L. Old man, southernwood.

Water and acetone extracts of the whole plant were nontoxic to mosquito larvae.--Hartzell (89).

ARTEMISIA ABSINTHIUM L. Wormwood.

Water and acetone extracts of the leaves, stems, and flower heads were nontoxic to mosquito larvae.--Hartzell (89).

Alcohol, acetone, or benzene extracts of the whole plant showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

In Arabia, flowers and leaves of this plant are placed between the pages of books to preserve them from attack by harmful insects.--Longo (132).

The plant is used by Italian farmers to protect grain in storehouses from attack by *Tinea granella*, *Sitotroga cerealella*, and *Calandra granaria*.--Ciaravellini (50).

An aqueous extract of the leaves was only slightly toxic to American cockroaches, and nontoxic to German cockroaches. An alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and *Aedes* mosquito.--Heal and coworkers (93).

ARTEMISIA ANNUA L.

ARTEMISIA CALIFORNICA Less.

Aqueous extracts of the upper parts and flower heads were nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

ARTEMISIA CINA Berg.

The petroleum ether, ethyl ether, and alcohol extracts of the plant were nontoxic to codling moth larvae.--Jacobson (108).

ARTEMISIA GNAPHALODES Nutt.

An aqueous extract of the tops, leaves, and flower heads was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ARTEMISIA LUDOVICIANA Nutt.

An aqueous extract of the stems and leaves was toxic to American cockroaches when in-

jected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An aqueous extract of the whole plant was nontoxic to these species of cockroaches and to milkweed bugs.--Heal and coworkers (93).

ARTEMISIA NOVA A. Nels. Sage.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

Acetone extracts of the aerial portion were somewhat effective against codling moths but not against German cockroaches.--Jacobson (108).

ARTEMISIA SUKSDORFII Piper.

An acetone extract of the leaves was nontoxic to mosquito larvae.--Jacobson (108).

ARTEMISIA TRIDENTATA Nutt. Sagebrush.

An acetone extract of the stems was nontoxic to mosquito larvae. A crystalline compound isolated from the petroleum ether extract of the whole plant was also nontoxic to these larvae.--Jacobson (108).

Aqueous extracts of the upper parts and of the tops, leaves, and flowers were nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

ARTEMISIA VULGARIS L. Mugwort.

Water and acetone extracts of the tops and seeds were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

The plant was toxic to flies, mosquito larvae, lice, cockroaches, and bugs (bedbugs?).--Petrischeva (172).

ASPILIA HOLSTII O. Hoffm.

An aqueous extract of the stems, leaves, and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the stems and roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ASTER CANESCENS Pursh.

An aqueous extract of the stems, leaves, and flowers was toxic to German cockroaches, slightly toxic to American cockroaches, and nontoxic to milkweed bugs.--Heal and coworkers (93).

ASTER FILIFOLIUS Vent.

An aqueous extract of the stems, leaves, and flowers was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ASTER GLABRIUSCULUS (Nutt.) Torr. & Gray. Synonym: Xylorhiza glabriuscula.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ASTER NOVAE-ANGLIAE L.

An aqueous extract of the tops, leaves, and flowers was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ASTER PUNICEUS L.

An aqueous extract of the roots was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ATRACTYLIS GUMMIFERA L. Add-add, addad.

The natives of Morocco are reported to use the root as an insecticide by burning it on red cinders. An acetone extract of the root had no contact effect on the willow aphis, Pterochlorus saligna. Aqueous and acetone extracts showed neither toxicity nor repellency to diamondback moth larvae, but were strongly repellent to adult mustard beetles and somewhat toxic to tomato moth larvae. The powdered root was nontoxic to diamondback moth larvae.--Tattersfield and coworkers (209).

ATRACTYLIS LYRATA Sieb. & Zucc.

An aqueous extract of the whole plant was nontoxic to German and American cock-

roaches and milkweed bugs.--Heal and coworkers (93).

BACCHARIS CINNAMOMIFOLIA H. B. K.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An extract of the roots was toxic to American cockroaches.--Heal and coworkers (93).

BACCHARIS CONFERTA H. B. K.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BACCHARIS CORIDIFOLIA DC.

An aqueous extract of the branches and leaves was toxic, and an extract of the branchlets, leaves, and flowers was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

BACCHARIS EMORYI Gray.

An aqueous extract of the branches and stems was toxic to German and American cockroaches.--Heal and coworkers (93).

BACCHARIS FEVILLEI DC.

An aqueous extract of the tops, leaves, and fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BACCHARIS FLORIBUNDA H. B. K. Niquivau.

An acetone extract of the plant was nontoxic to mosquito larvae.--Jacobson (108). Aqueous extracts of the roots and of the stems and leaves were toxic to American cockroaches but not to German cockroaches and milkweed bugs. A petroleum ether extract of the roots was toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and confused flour beetles. Alcohol and chloroform extracts were nontoxic to these insects as well as to Aedes mosquito larvae.--Heal and coworkers (93).

BACCHARIS GENISTELLOIDES (Lam.) Pers.

An aqueous extract of the stems was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BACCHARIS GLUTINOSA Pers.

An aqueous extract of the leaves was highly toxic, of the stems fairly toxic, and of the tops and flower heads slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol, petroleum ether, and chloroform extracts were slightly toxic to black carpet beetle larvae and nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

BACCHARIS HALIMIFOLIA L.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

BACCHARIS ODORATA var. BALSAMIFERA.

An aqueous extract of the upper parts was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BACCHARIS POLYANTHA H. B. K.

An aqueous extract of the stems was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BACCHARIS PTERONIOIDES DC.

An aqueous extract of the bark was highly toxic to American cockroaches but nontoxic to German cockroaches. Alcohol, petroleum ether, and chloroform extracts of the branches and leaves were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

BACCHARIS SAROTHROIDES Gray.

An aqueous extract of the branches was toxic to German and American cockroaches.--Heal and coworkers (93).

BACCHARIS SERGILOIDES Gray.

BACCHARIS THESIOIDES H. B. K.

Aqueous extracts of the upper parts were toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BAHIA OPPOSITIFOLIA DC.

Aqueous extracts of the branchlets and leaves and of the roots were nontoxic to German and American cockroaches and milkweed bugs. An extract of the roots, leaves, and branches was slightly toxic to American cockroaches only.--Heal and coworkers (93).

BAILEYA MULTIRADIATA Haw. & Gray.

An aqueous extract of the stems was toxic and of the flower heads nontoxic to American cockroaches. Both extracts were nontoxic to German cockroaches.--Heal and coworkers (93).

BALDUINA UNIFLORA Nutt.

An aqueous extract of the stems and flowers was nontoxic to German and American cockroaches.--Heal and coworkers (93).

BALSAMORHIZA MACROPHYLLA Nutt.

An aqueous extract of the roots was only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BALSAMORHIZA SAGITTATA (Pursh.) Nutt. Balsamroot.

The powdered mixed stems and leaves f this plant, reported to be insect-resistant, were slightly toxic to pea aphids. owdered roots and mixed stems and leaves ere ineffective on armyworms, two-spotted pider mites, and large milkweed bugs. cetone extractives of the roots, the stems nd leaves, and the flowers were all ineffective on these insects and on adult ouse flies.--Jacobson (108).

An aqueous extract of the roots was only ightly toxic to American cockroaches and ntoxic to German cockroaches and milkeed bugs.--Heal and coworkers (93).

BEBBIA JUNCEA (Benth.) Greene.

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

BELLIS PERENNIS L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

BERLANDIERA SUBACAULIS Nutt.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BIDENS FRONDOSA L.

An aqueous extract of the stems, leaves, and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BIDENS PILOSA L.

An aqueous extract of the whole plant was toxic, and of the tops, fruits, and flowers very toxic, to American cockroaches, but not to German cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae and nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and webbing clothes moth and *Aedes* mosquito larvae.--Heal and coworkers (93).

BLUMEA BALSAMIFERA (L.) DC.

An aqueous extract of the leaves was toxic to German and American cockroaches.--Heal and coworkers (93).

BOLTONIA ASTEROIDES (L.) L' Hér.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BRACHYGLOTTIS REPANDA Forst.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BRACHYLAENA HUTCHINSII Hutchison.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BRICKELLIA ARGUTA Robinson.

BRICKELLIA INCANA Gray.

Aqueous extracts of the stems, leaves, and flowers of these species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BRICKELLIA OBLONGIFOLIA Nutt.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BYRSOCARPUS ORIENTALIS. Synonym: Rourea orientalis.

An aqueous extract of the stems was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CACALIA MUHLENBERGII (Sch. Bip.) Fern.

An aqueous extract of the stems, leaves, and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CACALIA TUBEROSA Nutt.

Aqueous extracts of the flower heads and of the leaves were nontoxic, and an extract of the roots was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CALEA GLOMERATA Klatt.

Some parts of the plant were toxic as dusts or extracts to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CALEA URTICIFOLIA (Mill.) DC.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CALEA ZACATECHICHI Schlecht.

An aqueous extract of the stems, leaves, and flowers was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CARPHEPHORUS BELLIDIFOLIUS (Michx.) Torr. & Gray.

An aqueous extract of the tops and flower heads was nontoxic to German and American cockroaches and milkweed bugs. An extract of the young whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CARTHAMUS TINCTORUS L.

An aqueous extract of the tops and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHAENACTIS DOUGLASII (Hook.) Hook. & Arn.

An aqueous extract of the whole plant with flowers was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

CHAETANTHERA SERRATA Ruiz. & Pavon.

An aqueous extract of the whole plant was toxic to American cockroaches when in-

jected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CHAPTALIA TOMENTOSA Vent.

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CHRYSANTHEMUM ARCTICUM L.

An aqueous extract of the flower heads was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CHRYSANTHEMUM BALSAMITA L. Costmary.

An acetone extract, but not a water extract, of the leaves was toxic to mosquito larvae.--Hartzell (89).

CHRYSANTHEMUM LEUCANTHEMUM L. Oxeye daisy.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CHRYSANTHEMUM PARTHENIUM (L.) Bernh. Feverfew.

Alcohol, acetone, or benzene extracts of the flower heads and of the stems and leaves showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

CHRYSANTHEMUM sp. Azaleamum.

Water and acetone extracts of the leaves, stems, and flowers were nontoxic to mosquito larvae.--Hartzell (89).

CHRYSOCOMA TENUIFOLIA Berg.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CHRYSOPSIS VILLOSA (Pursh.) Nutt.

An aqueous extract of the tops and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CHRYSOTHAMNUS NAUSEOSUS (Pall.) Britton.

An aqueous extract of the tops and flower heads was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CHUQUIRAGA MICROPHYLLA Humb. & Bonpl.

An aqueous extract of the stems, leaves, and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CIRSIUM ARVENSE (L.) Scop.

An aqueous extract of the whole plant with flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CLIBADIUM ARBOREUM J. D. Sm.

An aqueous extract of the leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

CLIBADIUM EROSUM (Sw.) DC.

Extracts of the seed or fruit were highly toxic to mosquito larvae.--Sievers and coworkers (197).

The powdered flowers with fruits, leaves, bark, and wood each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

CLIBADIUM HETEROTRICHUM Blake. Huaca.

CLIBADIUM SYLVESTRE (Aubl.) Baill. Synonym: C. vargasii. Nivre.

An acetone extract of the leaves was nontoxic to mosquito larvae.--Jacobson (108).

CLIBADIUM SURINAMENSE L.

The powdered aerial portions were highly toxic to silkworm larvae but not to Mexican

bean beetle larvae, potato aphids, and bean aphids.--Hansberry and Clausen (86).

Some of the plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

CLIBADIUM sp.

The powdered leaves and stems were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

Aqueous extracts of the stems and of the tops and leaves were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CONYZA CHILENSIS Spreng.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CONYZA COULTERI Gray. Synonym: Eschenbachia coulteri.

The powdered plant was slightly toxic to southern beet webworms but nontoxic to European corn borers. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were somewhat effective against codling moth larvae but ineffective against house flies.--Jacobson (108).

CONYZA LYRATA H. B. K.

The fresh plant material is tied above the head of the bed in El Salvador as a repellent to mosquitoes at night.--Wellman and van Severen (221).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

COREOPSIS GIGANTEA (Kellogg) Hall.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COREOPSIS GRANDIFLORA Nutt.

An aqueous extract of the stems, leaves, and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COREOPSIS MUTICA DC.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

COSMOS PEUCEDANIFOLIUS Wedd.

An aqueous extract of the stems and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CREPIS BURSIFOLIA L.

An aqueous extract of the branchlets and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

CREPIS VESICARIA L.

An aqueous extract of the branches and flower heads was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DICORIA CANESCENS Torr. & Gray.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DYSSODIA PAPPOSA (Vent.) Hitchc. Synonym: Boebera papposa.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ECHINACEA sp. Synonym: Brauneria sp.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ECLIPTA ALBA (L.) Hassk.

An aqueous extract of the whole plant was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

ELEPHANTOPUS CAROLINENSIS Raeusch.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ELEPHANTOPUS NUDATUS Gray.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ELEPHANTOPUS TOMENTOSUS L.

An aqueous extract of the roots and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ENCELIA CALIFORNICA Nutt.

An aqueous extract of the stems and roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ENCELIA FARINOSA Gray.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ENCELIA FARINOSA var. RADIANS Brandeg. Incienso.

The powdered plant was nontoxic to southern armyworms and variegated cutworms but toxic to melonworms and southern beet webworms.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borers. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were ineffective against house flies and clothes moth larvae but were toxic to codling moth larvae.--Jacobson (108).

ENCELIA FRUTESCENS Gray.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ENHYDRA FLUCTUANS Lour.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ERIGERON ACRIS L. Blue fleabane.

Acetone, alcohol, or benzene extracts of the flower heads and of the whole plant showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

ERIGERON ANNUUS (L.) Pers.

An aqueous extract of the upper parts and flowers was nontoxic to German and American cockroaches and milkweed bugs. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

ERIGERON BELLIDIASTRUM Nutt. Synonym: E. eastwoodiae.

The powdered whole plant was toxic to melonworm and southern beet webworm larvae but not to southern armyworm larvae. The petroleum ether extractive and the com-

bined ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies.--McGovran and coworkers (143).

The powdered plant was nontoxic to European corn borers, and extractives had no effect on codling moth larvae.--Jacobson (108).

ERIGERON CANADENSIS L. Synonym: Leptilon canadense. Horseweed, butterweed, Canadian fleabane.

The powdered whole plant was toxic to melonworm larvae but not to southern armyworm and southern beet webworm larvae. Petroleum ether and combined ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies.--McGovran and coworkers (143).

The powdered plant was nontoxic to European corn borers and extractives were ineffective against codling moth larvae.--Jacobson (108).

Alcohol, acetone, or benzene extracts of the flower heads and of the stems and leaves showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

An aqueous extract of the upper parts and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ERIGERON DIVARICATUS Michx. Synonym: Leptilon divaricatum. Dwarf fleabane.

ERIGERON DIVERGENS Torr & Gray. Spreading fleabane.

ERIGERON FLAGELLARIS Gray. Synonym: E. macdougalii, E. tonsus. Running fleabane.

ERIGERON NUDIFLORUS Buckl. Synonym: E. commixtus.

These species, when tested as powders, were toxic to melonworm larvae but not to southern armyworm larvae. E. bellidiastrum was the most toxic to southern beet webworm larvae. Petroleum ether extractives and combined ethyl ether, chloroform, and alcohol extractives of all species were nontoxic to house flies.--McGovran and coworkers (143).

The powdered plants were nontoxic to European corn borers and their extractives were ineffective against codling moth larvae.--Jacobson (108).

ERIGERON GLABELLUS subsp. PUBESCENS (Hook.) Cronq.

Alcohol and chloroform extracts of the plant were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ERIGERON INORNATUS Gray.

An aqueous extract of the tops and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ERIGERON LINIFOLIUS Willd.

ERIGERON MODESTUS Gray.

ERIGERON REPENS Gray.

ERIGERON sp.

The powdered whole plant of E. repens was the only one of these species which showed no toxicity to melonworm larvae. They were all nontoxic to southern beet webworm and southern armyworm larvae. Petroleum ether extractives and combined ethyl ether, chloroform, and alcohol extractives were all nontoxic to house flies.--McGovran and coworkers (143).

Only powdered E. repens was toxic to European corn borers. Extractives of all species, except E. linifolius and E. sp., showed little or no effect on codling moth larvae.--Jacobson (108).

ERIOCEPHALUS GLABER Thunb.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ERIOPHYLLUM LANATUM var. INTEGRIFOLIUM (Hook.) Smiley.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German

cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ESPELETIA CORYMBOSA Humb. & Bonpl.

An aqueous extract of the tops and flower heads was slightly toxic to American cockroaches, and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ESPELETIA HARTWEGIANA Sch. Bip.

An aqueous extract of the stems, leaves, and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ETHULIA CONYZOIDES L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* mosquito. The chloroform extract was nontoxic to webbing clothes moth and black carpet beetle larvae. An aqueous extract of the tops and flowers was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An extract of the roots was nontoxic to both species of cockroaches and to milkweed bugs.--Heal and coworkers (93).

EUPATORIUM AGERATIFOLIUM DC.

An aqueous extract of the branchlets, leaves, and flower heads was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

EUPATORIUM ALBUM L.

An aqueous extract of the tops, leaves, and fruiting inflorescence was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

EUPATORIUM AROMATICUM L.

An aqueous extract of the upper parts and flowers was nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract of the whole plant was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Anopheles* mosquito. Alcohol and chloroform extracts were nontoxic to all these insects and to *Aedes* mosquito larvae.--Heal and coworkers (93).

EUPATORIUM CAPILLIFOLIUM (Lam.) Small. Cypress weed.

The powdered whole plant was nontoxic to southern armyworms, melonworms, and Hawaiian beet webworms.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. An acetone extractive showed some toxicity to codling moths. The combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were ineffective against codling moths and house flies, but showed some toxicity to German cockroaches.--Jacobson (108).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts of the tops and flower heads were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and *Aedes* and *Anopheles* moquitoes.--Heal and coworkers (93).

EUPATORIUM COMPOSITIFOLIUM Walt. Synonym: *E. coronopifolium*. Dogfennel.

The powdered whole plant was ineffective against southern armyworms, melonworms, Hawaiian beet webworms, cross-striped cabbage worms, and cabbage loopers.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies, German cockroaches, and codling moth larvae.--Jacobson (108).

EUPATORIUM HAVANENSE H. B. K. Shrubby boneset.

The powdered stems and roots were ineffective against southern armyworms, melonworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered stems and roots were nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies and codling moth larvae.--Jacobson (108).

EUPATORIUM HYSSOPIFOLIUM L.

An aqueous extract of the tops and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EUPATORIUM OCCIDENTALE Hook.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

EUPATORIUM ODORATUM L.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the upper parts was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

EUPATORIUM PERFOLIATUM L.

An aqueous extract of the leaves was toxic to German and American cockroaches.--Heal and coworkers (93).

EUPATORIUM PERSICIFOLIUM H. B. K.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EUPATORIUM PURPUREUM L. Queen of the meadow.

An acetone extract of the leaves was nontoxic to mosquito larvae.--Hartzell (90).

EUPATORIUM ROTUNDIFOLIUM L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

EUPATORIUM RUGOSUM Houtt. Synonym: E. urticaefolium. White snakeroot.

The powdered plant was nontoxic to southern armyworms and southern beet webworms.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to codling moth larvae and house flies.--Jacobson (108).

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

EUPATORIUM VERBENAEFOLIUM Michx.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EUPATORIUM WRIGHTII Gray.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

EUPATORIUM sp.

An aqueous extract of the leaves was toxic to American cockroaches but not to German cockroaches. An extract of the stems and leaves was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. Extracts of the roots and of the whole plant were nontoxic to all these insects.--Heal and coworkers (93).

FLAVERIA BIDENTIS (L.) Kuntze.

An aqueous extract of the stems, leaves and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

FLAVERIA TRINERVIA (Spreng.) Mohr.

An aqueous extract of the whole plant was nontoxic to German and American

cockroaches and milkweed bugs.--Heal and coworkers (93).

FLOURENSIA CERNUA DC.

Aqueous extracts of the stems and of the upper parts were toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

FLOURENSIA RESINOSA (Brandeg.) Blake.

An aqueous extract of the branches and leaves was toxic to German cockroaches and milkweed bugs but not to American cockroaches.--Heal and coworkers (93).

FRANSERIA ARTEMISIOIDES Willd.

Aqueous extracts of the tops, leaves, and flowers and of the branches and leaves were toxic to American and German cockroaches but not to milkweed bugs. Alcohol, petroleum ether, and chloroform extracts of the branches, leaves, and flowers were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Corresponding extracts of the stems and leaves were nontoxic to all these insects.--Heal and coworkers (93).

FRANSERIA CHENOPODIFOLIA Benth.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

FRANSERIA CONFERTIFLORA (DC.) Rydb.

The powdered plant was nontoxic to southern armyworms and melonworms.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to codling moth larvae and house flies.--Jacobson (108).

An aqueous extract of the branches, leaves, and flowers was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

FRANSERIA DELTOIDEA Torr.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

FRANSERIA DUMOSA Gray.

FRANSERIA ERIOCENTRA Gray.

FRANSERIA ILICIFOLIA Gray.

Aqueous extracts of the branches and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GAILLARDIA ARISTATA Pursh.

GAILLARDIA LANCEOLATA Michx.

An aqueous extract was nontoxic to German and American cockroaches.--Heal and coworkers (93).

GAILLARDIA PULCHELLA Foug.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GARBERIA FRUTICOSA (Nutt.) Gray.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GEIGERIA PASSERINOIDES Harv.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

GERBERIA JAMESONII Bolus. Gerbera, Transvaal daisy.

Water and acetone extracts of the stems were nontoxic to mosquito larvae.--Hartzell (89).

GNAPHALIUM LEUCOCEPHALUM Gray.

The powdered plant was nontoxic to southern armyworms and southern beet webworms.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extracts were toxic to codling moth larvae but not to house flies.--Jacobson (108).

GNAPHALIUM OBTUSIFOLIUM L.

An aqueous extract of the whole plant with flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

GNAPHALIUM sp.

An aqueous extract of the tops and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GRINDELIA BOLIVIANA Rusby.

An aqueous extract of the branchlets, leaves, and flowers was nontoxic to German and American cockroaches.--Heal and coworkers (93).

GRINDELIA NANA Nutt.

An aqueous extract of the flowers, leaves, and roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GRINDELIA PERENNIS A. Nels.

A petroleum ether extract of the whole plant was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and _Aedes_ and _Anopheles_ mosquitoes. Alcohol and chloroform extracts were nontoxic to all these species.--Heal and coworkers (93).

GRINDELIA ROBUSTA Nutt.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs. An extract of the leaves was toxic to German cockroaches but not to American cockroaches.--Heal and coworkers (93).

GRINDELIA SQUARROSA (Pursh) Dunal.

An aqueous extract of the tops, leaves, and flowers was toxic to German cockroaches but not to American cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and _Aedes_ and _Anopheles_ mosquitoes. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

GRINDELIA TARAPACANA Phil.

An aqueous extract of the tops and flower heads was toxic to German and American cockroaches but not to milkweed bugs.--Heal and coworkers (93).

GRINDELIA sp.

An aqueous extract of the roots and stems was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

GUTIERREZIA DRACUNCULOIDES. Synonym: _Amphiachyris dracunculoides_.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GUTIERREZIA MICROCEPHALA (DC.) Gray. Synonym: _G. filifolia, Brachyris microcephala_. Broomweed.

The powdered whole plant was nontoxic to southern armyworms, melonworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extracts had little or no effect on codling moth larvae and house flies.--Jacobson (108).

GUTIERREZIA SAROTHRAE (Pursh) Britt. & Rusby.

An aqueous extract of the upper parts and leaves was nontoxic to American and German cockroaches.--Heal and coworkers (93).

GYNOXIS BUXIFOLIA Cass.

An aqueous extract of the branches and leaves was toxic to German and American cockroaches.--Heal and coworkers (93).

HELENIUM AUTUMNALE L. Sneezeweed.

HELENIUM BADIUM (Gray) Greene.

HELENIUM ELEGANS DC.

HELENIUM MICROCEPHALUM DC.

HELENIUM MONTANUM Nutt.

HELENIUM QUADRIDENTATUM Labill.

HELENIUM TENUIFOLIUM Nutt. Bitterweed.

Both helenalin, isolated from autumnale, microcephalum, and quadridentatum, and tenulin, isolated from the other species, were pratically worthless when applied as sprays against the green peach aphid, adults and larvae of the Mexican bean beetle, adult American cockroaches, and house flies. When applied as 5 percent acetone solutions, they showed some toxicity to Mexican bean beetle larvae.--McGovran and coworkers (144).

HELENIUM AUTUMNALE L.

An aqueous extract of the flower heads was toxic to German and American cockroaches. An extract of the stems and leaves was toxic to German cockroaches only.--Heal and coworkers (93).

HELENIUM BIGELOVII Gray.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

HELENIUM ELEGANS DC.

The powdered plant was toxic to melonworms but not to southern armyworms and large milkweed bugs.--Bottger and Jacobson (36).

An aqueous extract of the whole plant was toxic to American cockroaches, but not to German cockroaches.--Heal and coworkers (93).

HELENIUM HOOPESII Gray.

An aqueous extract of the roots, stems, and flowers was toxic to American cockroaches but not German cockroaches and milkweed bugs. An extract of the whole plant with flowers was nontoxic to all these insects.--Heal and coworkers (93).

HELENIUM LACINIATUM Gray. Rosilla.

Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the flower heads were nontoxic to southern armyworms and melonworms but showed some toxicity to southern beet webworms.--Bottger and Jacobson (36).

The flower heads are reported in Mexico to be insecticidal. Combined petroleum ether, ethyl ether, chloroform, and alcohol extracts of the flower heads were nontoxic to European corn borer larvae, codling moths, and house flies.--Jacobson (108).

HELENIUM MEXICANUM H. B. K. Chapuz, cabezona, rosilla de puebla.

The powdered flower heads are reported to be used to kill lice and screwworms in Mexico. The powdered material was nontoxic to southern armyworms, melonworms, European corn borers, adult body lice, and screwworms, but showed some toxicity to southern beet webworms. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were toxic to codling moth larvae but not to house flies, body lice, and screworms.--Jacobson (108).

HELENIUM MICROCEPHALUM DC.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HELENIUM QUADRIDENTATUM Labill.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An aqueous extract of the flower heads was highly toxic to American cockroaches and toxic to German cockroaches.--Heal and coworkers (93).

HELENIUM TENUIFOLIUM Nutt.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

HELIANTHUS PUMILUS Nutt.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and

milkweed bugs.--Heal and coworkers (93).

HELIOPSIS CANESCENS H. B. K.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HELIOPSIS GRACILIS Nutt.

The powdered leaves and powdered stems were both ineffective against armyworms, celery leaf tiers, large milkweed bugs, pea aphids, and two-spotted spider mites. Chloroform and alcohol extractives of the leaves and alcohol extractives of the roots and of the flower heads were all nontoxic to these insects.--Bottger and Jacobson (36).

Petroleum ether extractives of the roots and of the stems were quite toxic and moderately toxic, respectively, to house flies. A petroleum ether extractive of the leaves was nontoxic to house flies, but an extractive of the flower heads was toxic to this insect. Ethyl ether and chloroform extractives of the petroleum ether-extracted parts were nontoxic to this insect.--Gersdorff and Mitlin (72).

HELIOPSIS HELIANTHOIDES (L.) Sweet.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the stems and leaves was nontoxic to these insects.--Heal and coworkers (93).

A petroleum ether extractive of the roots was highly toxic to adult house flies. A fraction isolated from the neutral portion of this extractive was as toxic as pyrethrins to house flies. High-vacuum distillation of this fraction destroyed its activity but did not seriously affect its knockdown power.--Jacobson (108).

HELIOPSIS HELIANTHOIDES var. SCABRA (Pers.) Fern. Synonym: H. scabra. Oxeye.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

Petroleum ether extractives of the roots and of the stems were quite toxic and moderately toxic, respectively, to house flies. An extract of the leaves was moderately toxic, but an extract of the flower heads was nontoxic to this insect. Ethyl ether and chloroform extractives of the petroleum ether-extracted parts were nontoxic to house flies.--Gersdorff and Mitlin (72).

The powdered roots were toxic to armyworms but not to celery leaf tiers, pea aphids, and two-spotted spider mites. A 25-percent Pyrax dust of the alcohol extractive of the petroleum ether-extracted roots was nontoxic to all these insects. A 25 percent Pyrax dust of the flower heads showed some toxicity to two-spotted spider mites but not to the other insects. A 20-percent Pyrax dust of the stems showed some toxicity to celery leaf tiers only, and a dust of the leaves was nontoxic to all these insects.--Bottger and Jacobson (36).

Scabrin, a pungent, unsaturated isobutylamide isolated from the petroleum ether extractive of the roots, was more toxic than pyrethrins to house flies. The extractive also contains an unidentified constituent with considerable toxicity to house flies.--Jacobson (107).

At the 25 percent mortality level with house flies scabrin and pyrethrins were equally toxic, but at the 90 percent level scabrin was about 1.6 times as toxic as pyrethrins. Sulfoxide and Synergist 264 increased the toxicity of scabrin severalfold and greatly increased its stability in solutions.--Gersdorff and Mitlin (73).

Several commercial antioxidants effectively stabilized scabrin in kerosene sprays for a period of one and one-half years.--Mitlin and Gersdorff (150).

HELIOPSIS LONGIPES (Gray) Blake. Chilcuan, chilcuague, peritre del pais.

The roots are used as an insecticide in Mexico. Petroleum ether extractives and the combined ethyl ether, chloroform, and alcohol extractives of the petroleum ether-extracted roots were nontoxic to European corn borers.--Jacobson (108).

From the petroleum ether extractive of the roots of this plant, originally thought to be Erigeron affinis, an amide designated "affinin" was isolated. It proved to be highly toxic to house flies, Aedes mosquitoes (adults and larvae), codling moths, and body lice, but was not effective as a body louse ovicide.--Acree and coworkers (4,5).

Affinin was isolated from authentic roots of this plant and shown to be toxic to house flies.--Jacobson and coworkers (109).

The petroleum ether extractive of the roots was highly toxic to house flies, adult Aedes aegypti mosquitoes, melonworm and southern beet webworm larvae, and quash bug nymphs, but it was nontoxic to southern armyworm larvae. Combined ethyl ether, chloroform, and alcohol extractives of the petroleum ether-extracted roots were nontoxic to all these insect species. A distillate obtained from the petroleum ether extractive was highly toxic to house flies.--McGovran and coworkers (143).

An aqueous extract of the roots was toxic to milkweed bugs but not to German and American cockroaches. A petroleum ether extract was toxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Anopheles mosquito. An alcohol extract was toxic to milkweed bugs and larvae of the webbing clothes moth and Aedes mosquito but nontoxic to the other insect species. A chloroform extract was toxic to milkweed bugs and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito, and nontoxic to the other insect species.--Heal and coworkers (93).

HELIOPSIS PARVIFOLIA Gray.

The powdered stems were somewhat toxic to celery leaf tiers but not to armyworms and two-spotted spider mites. The powdered leaves and roots were both nontoxic to these insects. Alcohol extractives of the petroleum ether-extracted roots and stems were nontoxic to these insects and to green dock beetles.--Bottger and Jacobson (36).

Petroleum ether extractives of the roots, the stems, and the leaves were all toxic to house flies. An extractive of the flower heads was nontoxic to this insect. Ethyl ether and chloroform extractives of the petroleum ether-extracted parts were nontoxic to house flies.--Gersdorff and Mitlin (72).

HEMIZONIA FASCICULATA (DC.) Torr. & Gray.

HEMIZONIA KELLOGGII Greene.

Aqueous extracts of these species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HEMIZONIA PUNGENS (Hook. & Arn.) Torr. & Gray.

An aqueous extract of the stems, leaves, and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HERTIA PALLENS.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs. An extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

HETEROTHECA GRANDIFLORA Nutt.

HIERACIUM AURANTIACUM L.

Aqueous extracts of the whole plant were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HETEROTHECA SUBAXILLARIS (Lam.) Britt. & Rusby.

An aqueous extract of the flower heads was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HIERACIUM JAPONICUM Franch. & Sav.

A water suspension of the combined leaves, stems, and roots was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

HOFMEISTERIA PLURISETA Gray.

An aqueous extract of the branches, leaves, and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HYMENOCLEA SALSOLA Torr. & Gray.

An aqueous extract of the branches and branchlets was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HYMENOXYS FLORIBUNDA (Gray) Cockerell.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

HYMENOXYS GRANDIFLORA (Torr. & Gray) Parker. Synonym: Rydbergia grandiflora.

An aqueous extract of the whole plant with flowers was slightly toxic to American

cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HYMENOXYS HAENKEANA DC.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HYMENOXYS ODORATA DC. Synonym: Actinea odorata. Bitter rubberweed, bitterweed.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HYMENOXYS RICHARDSONII (Hook.) Cockerell.

An aqueous extract of the whole plant with flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HYPOCHAERIS QUITENSIS.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HYPOCHAERIS sp.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ICHTHYOTHERE RUFA Gardn.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

ICHTHYOTHERE TERMINALIS (Spreng.) Blake.

Aqueous extracts of the roots and of the stems and leaves were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

INULA CONYZA DC. Fleawort.

Alcohol, benzene, or acetone extracts of the flower heads and of the stems and leaves showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

INULA GRAVEOLENS (L.) Desf. Stinkwort.

An aqueous extract of the plant was not repellent to the Australian sheep blowfly.--Waterhouse (220).

INULA HELENIUM L. Elecampane.

The plant was toxic to flies, mosquito larvae, lice, and bugs (bedbugs?).--Petrischeva (172).

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An extract of the upper parts was nontoxic to these species. An extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An extract of the tops, leaves, and flowers was toxic to American cockroaches only.--Heal and coworkers (93).

ISOCARPHA OPPOSITIFOLIA (L.) R. Br.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

IVA AXILLARIS Pursh.

An aqueous extract of the tops and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

IVA FRUTESCENS L.

An aqueous extract of the tops and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

IVA XANTHIFOLIA Nutt.

Aqueous extracts of the upper parts and leaves and of the tops, leaves, and flower

were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

KUHNIA EUPATORIOIDES var. CORYMBULOSA Torr. & Gray. Synonym: K. jacobaea.

An aqueous extract of the tops, leaves, and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LACTUCA VIROSA L. Wild lettuce.

Water and acetone extracts of the leaves were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

LASIOSPERMUM RADIATUM Trevir.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LIATRIS GRAMINIFOLIA (Walt.) Willd.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LUINA HYPOLEUCA Benth.

An aqueous extract of the whole plant was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

LYGODESMIA JUNCEA D. Don.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MACHAERANTHERA VARIANS Greene.

An aqueous extract of the whole plant with flowers was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the tops and flowers were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

MADIA GLOMERATA Hook.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs. An extract of the upper parts and flowers was toxic to both species of cockroaches but not to milkweed bugs, while an extract of the stems and flowers was toxic only to German cockroaches. An alcohol extract of the stems and flowers was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

MADIA GRACILIS (J. E. Sm.) Keck.

An aqueous extract of the tops, leaves, and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MALACOTHRIX FENDLERI Gray.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MATRICARIA CHAMOMILLA L. Hungarian chamomile.

Water and acetone extracts of the whole plant were nontoxic to mosquito larvae.--Hartzell (89).

MATRICARIA GLOBIFERA Fenzl.

An aqueous extract of the flower heads was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the whole plant was only slightly toxic to American cockroaches and nontoxic to the other insects.--Heal and coworkers (93).

MATRICARIA INODORA L. Scentless false chamomile, mayweed.

The powdered flower heads were as effective as commercial pyrethrum powder against Musca autumnalis. The powdered dried leaves were ineffective.--Reingard and Zabud'ko-Reingard (184).

"Matricaria ester", isolated from the essential oil of Norwegian flower heads, was nontoxic to adult house flies.--Jacobson (108).

MATRICARIA MATRICARIOIDES (Less.) Porter. Synonym: M. suaveolens. Rayless chamomile.

The powdered flower heads were fairly toxic to larvae of the diamondback moth. Alcohol, acetone, or benzene extracts of the whole plant and of the flower heads showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MICROGLOSSA VOLUBILIS DC.

Aqueous extracts of the roots, and of the stems, leaves, and flowers were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MIKANIA GLOMERATA Spreng.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MIKANIA MICRANTHA H. B. K. Synonym: M. orinocensis. Guaco.

The powdered roots were ineffective against southern armyworms, melonworms, and blister beetles.--Bottger and Jacobson (36).

The plant is reported to be used as an insecticide in Honduras. The powdered roots were ineffective against body lice. Combined petroleum ether, ether, chloroform, and alcohol extractives of the roots were nontoxic to house flies and codling moth larvae.--Jacobson (108).

MONTANOA TOMENTOSA Cerv.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

NEMOSERIA NEOMEXICANA (Gray) Greene.

An aqueous extract of the flower heads was nontoxic to German and American cockroaches.--Heal and coworkers (93).

NEUROLAENA LOBATA (L.) R. Br.

An aqueous extract of one sample of whole plant was toxic to American, but not to German, cockroaches; an extract of a second sample was slightly toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs. Petroleum ether and chloroform extracts of the second sample were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

OPHRYOSPORUS ELEUTHERANTHERUS. Synonym: Eupatorium eleutheranthernum.

An aqueous extract of the tops, leaves, and fruits was toxic to American and German cockroaches but not to milkweed bugs.--Heal and coworkers (93).

OXYTENIA ACEROSA Nutt.

An aqueous extract of the whole plant was toxic to German and American cockroaches.--Heal and coworkers (93).

PARTHENIUM HISPIDUM Raf.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

PECTIS CAPILLARIS DC.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PECTIS PAPPOSA Harv. & Gray.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PEREZIA NANA Gray.

The powdered leaves and stems were toxic to southern armyworms and southern beet webworms, but not to melonworms.--Bottger and Jacobson (36).

The powdered leaves and stems were ineffective against European corn borers. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies and codling moth larvae.--Jacobson (108).

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PEREZIA RUNCINATA Lag.

The powdered roots were nontoxic to southern armyworms, melonworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered roots were nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies and codling moth larvae.--Jacobson (108).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PEREZIA WRIGHTII Gray. Synonym: P. arizonica.

The powdered plant was toxic to melonworms and southern beet webworms but not to southern armyworms and celery leaf tiers.--Bottger and Jacobson (36).

Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies and codling moth larvae.--Jacobson (108).

An aqueous extract of the whole plant with flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PETASITES PALMATUS Ait.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PETASITES sp.

An aqueous extract of the roots and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PICROSIA LONGIFOLIA D. Don.

Aqueous extracts of the roots and of the whole plant were slightly toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PIQUERIA TRINERVIA Cav.

An aqueous extract of the whole plant was nontoxic to American and German cockroaches, and to milkweed bugs.--Heal and coworkers (93).

PLAZIA ARGENTEA (D. Don) Kuntze.

An aqueous extract of the stems, leaves, and fruits was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

PLUCHEA CAMPHORATA (L.) DC.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PLUCHEA ODORATA (L.) Cass.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PLUCHEA QUITOC DC.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PODANTHUS OVATIFOLIUS Lag.

An aqueous extract of the branchlets and leaves was nontoxic to German and Ameri-

can cockroaches and milkweed bugs.--Heal and coworkers (93).

POROPHYLLUM GRACILE Benth.

An aqueous extract of one sample of whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A petroleum ether extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts were nontoxic to all these insects. An aqueous extract of a second sample of whole plant was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

POROPHYLLUM MACROCEPHALUM DC.

An aqueous extract of the tops and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

POROPHYLLUM RUDERALE (Jacq.) Cass.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PRENANTHES ALTISSIMA L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PROUSTIA PYRIFOLIA Lag.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PSATHYROTES ANNUA (Nutt.) Gray.

An aqueous extract of the whole plant was very toxic to German and American cockroaches but not to milkweed bugs.--Heal and coworkers (93).

PSIADIA TRINERVIA Willd.

Aqueous extracts of the stems and of the branchlets and leaves were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PSILOSTROPHE COOPERI (Gray) Greene.

An aqueous extract of the roots and stems was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. A petroleum ether extract was toxic to milkweed bugs and black carpet beetle larvae but not to German cockroaches, confused flour beetles, and webbing clothes moth larvae. Alcohol and chloroform extracts were nontoxic to these insects, as well as to Aedes mosquito larvae.--Heal and coworkers (93).

PSILOSTROPHE GNAPHALODES DC. Synonym: Riddellia archnoidea.

The powdered plant was nontoxic to southern armyworms, melonworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extracts had little effect on codling moth larvae and none on house flies.--Jacobson (108).

PSILOSTROPHE TAGETINA (Nutt.) Greene.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PTEROCAULON POLYSTACHYUM DC.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

PTEROCAULON PYCNOSTACHYUM (Michx.) Ell. Synonym: P. undulatum.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PULICARIA CRISPA (Pers.) Sch. Bip.

An aqueous extract of the whole plant was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

PULICARIA DYSENTERICA (L.) Gaertn. Fleabane.

Alcohol, acetone, or benzene extracts of the flower heads and of the stems and leaves showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

PULICARIA UNDULATA Kostel.

An aqueous extract of the tops and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RATIBIDA COLUMNARIS (Sims) D. Don. Nigger-head.

The powdered plant was nontoxic to southern armyworms, melonworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extracts had little effect on codling moth larvae and none on house flies.--Jacobson (108).

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RUDBECKIA AMPLEXICAULIS Vahl. Synonym: Ratibida amplexicaulis.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RUDBECKIA HIRTA L.

An aqueous extract of the tops and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RUDBECKIA LACINIATA L.

An aqueous extract of the stems, leaves, and roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RUDBECKIA OCCIDENTALIS Nutt.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SALMEA SCANDENS (L.) DC. Barbasco bejucillo.

An acetone extract of the stems was quite toxic to mosquito larvae.--Jacobson (108).

Aqueous extracts of the stems and leaves and of the flower heads were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SANTOLINA CHAMAECYPARISSUS L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SANVITALIA PROCUMBENS Lam.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SAUSSUREA LAPPA C. B. Clarke. Costus.

An acetone extract of the roots was nontoxic to mosquito larvae.--Jacobson (108).

SAUSSUREA sp.

An aqueous extract of the roots and stems was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle and webbing clothes moth.--Heal and coworkers (93).

SCHKUHRIA ABROTANOIDES Roth. Mata pulga.

The powdered plant was nontoxic to southern armyworms, melonworms, and European corn borers, but showed some toxicity to southern beet webworms. Combined petroleum ether, ethyl ether, chloroform, and alcohol extracts were toxic to codling moth larvae but not to house flies.--Jacobson (108).

Aqueous extracts of the whole plant and of the leaves and flowers were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SCHKUHRIA PINNATA (Lam.) Kuntze.

An aqueous extract of the whole plant was toxic to German cockroaches and slightly toxic to American cockroaches. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

SCHKUHRIA WISLIZENII Gray. Synonyms: S. flava, Tetracarpum flavum.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

SENECIO AUREUS L. Life root plant.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

An aqueous extract of the tops was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

SENECIO EHRENBERGIANUS Klatt.

The roots are reported to be used to kill ants in Mexico. The powdered roots were nontoxic to southern armyworms, melonworms, and European corn borer larvae, but were somewhat toxic to southern beet webworms. They had no repellent or toxic action against adult ants, Pheidole dentata, but may be attractive to this insect. Combined petroleum ether, ethyl ether, chloroform, and alcohol extracts were nontoxic to house flies and codling moth larvae.--Jacobson (108).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches. An extract of the leaves, stems, and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches. A petroleum ether extract of the whole plant was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts were nontoxic to these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

SENECIO LONGILOBUS Benth.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SENECIO RICHII Gray.

An aqueous extract of the branchlets, leaves, and flowers was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SENECIO SEEMANNII Sch. Bip.

SENECIO TRIANGULARIS Hook.

SENECIO sp.

Aqueous extracts of each species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

Powdered Senecio sp. was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

SERICOCARPUS LINIFOLIUS (L.) B.S.P.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SERRATULA INSULARIS Iljin.

Water suspensions of the roots, of the combined leaves and stems, and of the combined leaves, stems, and flowers were all nontoxic to Drosophila hydei larvae, but a suspension of the leaves alone was toxic to these larvae.--Yamaguchi and coworkers (233).

SIEGESBECKIA ORIENTALIS L.

An aqueous extract of the tops, leaves and flowers was toxic to American cock-

roaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SILPHIUM ASPERRIMUM Hook.

Petroleum ether, ethyl ether, and chloroform extractives of the roots were ineffective against house flies.--Jacobson (108).

SILPHIUM LACINIATUM L. Rosinweed.

An acetone extract of the root was nontoxic to mosquito larvae.--Hartzell (90).

SILYBUM MARIANUM (L.) Gaertn.

An aqueous extract of the stems, leaves, and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SOLIDAGO MICROGLOSSA DC.

A petroleum ether extract of the whole plant was toxic to milkweed bugs and larvae of the black carpet beetle and webbing clothes moth, but not to German cockroaches and Anopheles mosquito larvae. Alcohol and chloroform extracts were nontoxic to these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

SOLIDAGO OCCIDENTALIS Nutt.

An aqueous extract of the upper parts and flowers was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. A petroleum ether extract was toxic to black carpet beetle larvae but not to webbing clothes moth and Anopheles mosquito larvae. An alcohol extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

SOLIDAGO ODORA Ait.

Aqueous extracts of fragments and of the vhole plant were very toxic to American :ockroaches but not to German cockroaches .nd milkweed bugs. Alcohol, petroleum ther, and chloroform extracts were toxic o black carpet beetle larvae but not to ierman cockroaches, milkweed bugs, conised flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal nd coworkers (93).

SONCHUS OLERACEUS L.

An aqueous extract of the tops and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SPHAERANTHUS AFRICANUS L.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SPHAERANTHUS INDICUS L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SPILANTHES ACMELLA (L.) Murr.

Of seven plants tested against Anopheles mosquito larvae, only this plant showed sufficient larvicidal action to warrant further study. The active material was identified as spilanthol, N-isobutyl-4, 6-decadienamide. A cold water extract of the flowering tops killed 100 percent of mosquito larvae in 7 minutes. A suspension containing 1 part spilanthol in 5,000 parts water killed all mosquito larvae and pupae in 15 minutes.--Pendse and coworkers (167).

An ethyl ether extract of the flowering tops was effective against mosquito larvae in a dilution of 1:100,000 in water. Spilanthol appears to be the main active constituent. A patent regarding the use of the extract as a larvicide was applied for.--Pendse and coworkers (168).

A water suspension of the combined leaves and stems was toxic to Drosophila hydei larvae, but a suspension of the roots was nontoxic to these larvae.--Yamaguchi and coworkers (233).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SPILANTHES AMERICANA var. REPENS (Walt.) A. H. Moore. Synonym: S. repens.

A petroleum ether extractive of the flower heads and its neutral fraction both caused some knockdown in tests with house flies, but there was no mortality.--Jacobson (108).

An aqueous extract of the tops and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SPILANTHES OCYMIFOLIA A. H. Moore.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

SPILANTHES OLERACEA L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

Spilanthol at a dilution of 1:30,000 was very effective against Culex pipiens larvae, but it was ineffective at 1:100,000.--Aihara and Suzucki (6).

SPILANTHES sp.

An aqueous extract of the flower heads was highly toxic to German and American cockroaches, but not to milkweed bugs. An alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

STEVIA CATHARTICA Poepp. & Endl.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the roots was only slightly toxic to American cockroaches and nontoxic to the other insects.--Heal and coworkers (93).

STRUCHIUM SPARGANOPHORUM (L.) Kuntze. Synonym: Sparganophorus vaillantii.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TAGETES ERECTA L. African marigold.

The plant was nontoxic to aphids.--Huang (97).

Both a hexane extract of the flower heads and the oil therefrom were nontoxic to house flies and did not synergize pyrethrins.--Jacobson (108).

TAGETES FILIFOLIA Lag.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TAGETES FLORIDA Sweet.

TAGETES MINUTA L. Synonym: T. glandulifera. Stinking Roger.

Aqueous extracts of the stems, leaves, and flowers of each species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

The essential oil of T. minuta was not repellent to Aedes mosquitoes.--McCulloch and Waterhouse (142).

The essential oil of T. minuta did not repel the Australian sheep blowfly.--Waterhouse (220).

The essential oil from the leaves of T. minuta did not synergize pyrethrins in tests against adult house flies.--Kerr (114).

TAGETES MICROGLOSSA Benth.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

TAGETES PATULA L. Marigold.

Water and acetone extracts of the flowers were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the whole plant was toxic to German and American cockroaches.--Heal and coworkers (93).

TAGETES sp. Pericon.

A kerosene solution of an extract of this unidentified species was reported to be used in Mexico against bedbugs and mosquitoes. A prepared solution proved to be ineffective against bedbugs and Anopheles mosquito larvae.--Jacobson (108).

TANACETUM VULGARE L. Tansy.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

Alcohol, acetone, or benzene extracts of the flower heads and of the stems and leaves showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An extract of the upper parts and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TARAXACUM ALBIDUM Dahlst.

A water suspension of the leaves and flowers was nontoxic to Drosophila hydei larvae, but a suspension of the roots was toxic to these larvae.--Yamaguchi and coworkers (233).

TARAXACUM OFFICINALE Web. Dandelion.

Acetone and water extracts of the leaves and of the roots were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

TARCHONANTHUS CAMPHORATUS L.

Aqueous extracts of the branchlets and of the roots were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TESSARIA INTEGRIFOLIA Ruiz & Pavon.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TETRADYMIA NUTTALLII Torr. & Gray.

An aqueous extract of the branches and needles was nontoxic to German and American cockroaches.--Heal and coworkers (93).

THELESPERMA MEGAPOTAMICUM (Spreng.) Kuntze. Synonym: T. gracile.

An aqueous extract of the whole plant was nontoxic to American cockroaches.--Heal and coworkers (93).

TITHONIA ROTUNDIFOLIA (Mill.) Blake.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

TRIDAX PROCUMBENS L.

Aqueous extracts of the whole plant and of the flower heads were nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract of the flower heads was toxic to webbing clothes moth and black carpet beetle larvae but not to German cockroaches, milkweed bugs, and Anopheles mosquito larvae. An alcohol extract was toxic to black carpet beetle larvae only, while a chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

TRILISA CARNOSA (Small) Robinson. Synonym: Litrisa carnosa.

An aqueous extract of the tops and flowers was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

TRILISA ODORATISSIMA (Walt.) Cass.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

TRIXIS RADIALIS (L.) Kuntze.

An aqueous extract of the stems, leaves, and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

VANCLEVEA STYLOSA (Eastw.) Greene.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

VERBESINA ENCELIOIDES var. EXAURICULATA Robins. & Greenm.

Aqueous extracts of the flower heads and of the stems, leaves, and flowers were very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the whole plant were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

VERBESINA VIRGINICA L. Synonym: Phaethusa virginica. Virginia crownbeard.

The powdered stems and leaves were nontoxic to southern armyworms, melonworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered stems and leaves were ineffective against European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were effective against codling moth larvae but not against house flies.--Jacobson (108).

VERNONIA ANTHELMINTICA (L.) Willd.

An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

VERNONIA FASCICULATA Michx.

An aqueous extract of the tops and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

VERNONIA NOVEBORACENSIS (L.) Willd.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

VIGUIERA CORDIFOLIA Gray.

An aqueous extract of the branchlets and leaves was very toxic to American cockroaches when injected into the blood stream but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

VIGUIERA DENTATA (Cav.) Spreng.

Powdered roots, leaves, and stems were all nontoxic to armyworms, celery leaf tiers, and two-spotted spider mites.--Bottger and Jacobson (36).

Powdered roots, leaves, and stems were all nontoxic to European corn borer larvae. Petroleum ether, ethyl ether, and chloroform extractives of each of these parts and of the flower heads were all nontoxic to house flies.--Jacobson (108).

WEDELIA BIFLORA (L.) DC.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

WEDELIA GLAUCA (Ort.) O. Hoffm.

An aqueous extract of the whole plant was very toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

WEDELIA JACQUINI var. PARVIFLORA (Rich.) O. E. Schulz.

An aqueous extract of the flower heads was very toxic to German and American cockroaches but nontoxic to milkweed bugs.--Heal and coworkers (93).

WERNERIA LORENTZIANA Hieron.

An aqueous extract of an unidentified part of the plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

WYETHIA AMPLEXICAULIS Nutt.

An aqueous extract of the flower heads was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

XANTHIUM CANADENSE Mill.

An aqueous extract of the seedlings was toxic to German and American cockroaches but not to milkweed bugs. A petroleum ether extract of the young plant was toxic to black carpet beetle larvae but not to German cock-

roaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts were nontoxic to these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

XANTHIUM ITALICUM Mor.

An aqueous extract of the old whole plant with fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

XANTHIUM ORIENTALE L.

The powdered young seedlings were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

XANTHIUM SPINOSUM L.

An aqueous extract of the stems, leaves, and fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. A petroleum ether extract of the stems and leaves was toxic to milkweed bugs and black carpet beetle larvae but not to German cockroaches and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts were toxic only to black carpet beetle larvae. An alcohol extract of the tops and leaves was toxic to Aedes mosquito larvae but not to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Anopheles mosquito. A petroleum ether extract of the tops and leaves was toxic to black carpet beetle larvae only, while a chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

ZINNIA GRANDIFLORA Nutt. Prairie zinnia.

The powdered roots were slightly toxic to celery leaf tiers but not to pea aphids, two-spotted spider mites, and large milkweed bugs. Powdered stems and leaves were nontoxic to all these species of insects. Petroleum ether extractives of the roots and of the stems and leaves were ineffective against house flies.--Jacobson (108).

ZINNIA PUMILA Gray.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CONNARACEAE

AGELAEA NITIDA Sol.

Aqueous extracts of the bark, of the branchlets and leaves, and of the roots were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

AGELAEA PENTAGYNA (DC.) Radlk.

An aqueous extract of the fruits was toxic to German cockroaches but not to American cockroaches and milkweed bugs. Petroleum ether and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

BYRSOCARPUS ORIENTALIS (Baill.) Baker. Synonym: Rourea orientalis.

An aqueous extract of the stems was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CNESTIS BULLATA Radlk.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae but not to milkweed bugs and Aedes and Anopheles mosquito larvae. Alcohol and chloroform extracts were nontoxic to all these insects as well as to German cockroaches.--Heal and coworkers (93).

CONNARUS LAMBERTII (DC.) Britton.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ROUREA ERECTA (Blanco) Merr.

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ROUREA GLABRA H. B. K.

An aqueous extract of the fruits was toxic to German cockroaches, slightly toxic to

American cockroaches, and nontoxic to milkweed bugs. An extract of the roots was toxic only to American cockroaches.--Heal and coworkers (93).

ROUREA SURINAMENSIS Miq.

An aqueous extract of the seeds was toxic to German cockroaches and slightly toxic to American cockroaches.--Heal and coworkers (93).

CONVOLVULACEAE

CONVOLVULUS OCCIDENTALIS Gray.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches.--Heal and coworkers (93).

CUSCUTA AMERICANA L.

An aqueous extract of the stems and flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract was toxic to black carpet beetle and Aedes mosquito larvae but not to German cockroaches, milkweed bugs, and webbing clothes moth and Anopheles mosquito larvae. A chloroform extract was toxic only to black carpet beetle larvae.--Heal and coworkers (93).

CUSCUTA RACEMOSA Mart.

Alcohol and petroleum ether extracts of the stems were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

CUSCUTA sp.

Petroleum ether and chloroform extracts of the stems were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

DICHONDRA CAROLINENSIS Michx.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

EXOGONIUM MICRODACTYLUM (Griseb.) House.

An aqueous extract of the stems and leaves was nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

IPOMOEA CRASSICAULIS (Benth.) Robinson. Synonym: I. fistulosa.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the stems and leaves was toxic only to German cockroaches.--Heal and coworkers (93).

IPOMOEA JALAPA (L.) Pursh. Jalap.

An acetone extract of the root was toxic to mosquito larvae but a water extract was nontoxic to these larvae.--Hartzell (89).

IPOMOEA MURICATA Jacq.

The plant is used in India as a repellent for many household insects. A cold water extract of the leaves and stems killed no mosquito larvae in 24 hours.--Pendse and coworkers (167).

IPOMOEA NIL (L.) Roth. Synonym: Pharbitis nil.

The pulverized seeds from Kwangsi, China were effective against aphids.--Huang (97).

IPOMOEA PURGA Hayne.

An aqueous extract of the roots was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

JACQUEMONTIA TAMNIFOLIA (L.) Griseb.

Aqueous extracts of the young whole plant and of the whole plant with fruits were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

MARIPA SCANDENS Aubl.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milk-

weed bugs. An extract of the stems and leaves was toxic to American cockroaches only.--Heal and coworkers (93).

OPERCULINA TUBEROSA (L.) Meissn.

An aqueous extract of the stems, leaves, and fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

OPERCULINA TURPETHUM (L.) Silva Manso. Turpeth.

An acetone extract of the roots was nontoxic to mosquito larvae.--Hartzell (90).

QUAMOCLIT PENNATA (Desr.) Voigt. Synonym: Ipomoea Quamoclit. Cypress vine.

The pulverized seeds from Kwangsi, China were effective against aphids.--Huang and Chen (98).

RIVEA CORYMBOSA (L.) Hall. f.

Aqueous extracts of the seeds, stems, and leaves, and of the stems and leaves alone, were nontoxic to German and American cockroaches and milkweed bugs. An extract of the roots was slightly toxic to American cockroaches only.--Heal and coworkers (93).

CORIARIACEAE

CORIARIA ARBOREA Lindsay.

Aqueous extracts of the fruits and of the branches and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CORIARIA AUGUSTISSIMA Hook.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CORIARIA JAPONICA Gray.

An acetone extract of the fruits was toxic to Culex pipiens larvae. The toxicity was traced to the water-insoluble acidic portion of the extract.--Yamaguchi and coworkers (232).

CORIARIA RUSCIFOLIA L.

An aqueous extract of the seeds was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CORIARIA THYMIFOLIA Humb. & Bonpl.

An aqueous extract of the seeds and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs. Extracts of the bark and of the stems, leaves, and fruits were both nontoxic to all these insects.--Heal and co-workers (93).

CORNACEAE

CORNUS FLORIDA L. Flowering dogwood.

Acetone and water extracts of the bark were nontoxic to mosquito larvae.--Hartzell (89).

GARRYA GOLDMANII Woot. & Standl.

An aqueous extract of the roots was nontoxic to German and American cockroaches. --Heal and coworkers (93).

CORYNOCARPACEAE

CORYNOCARPUS LAEVIGATA Forst.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CRASSULACEAE

COTYLEDON DECUSSATA Sims.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

COTYLEDON PULVERULENTA Baker.

An aqueous extract of the young whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ECHEVERIA COLLOMAE (Rose) Kearney & Peebles. Synonym: Dudleya collomae.

An aqueous extract of the whole plant was toxic to American cockroaches when in-

jected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

KALANCHOE DAIGREMONTIANA Hamet & Perrier. Kalanchoe.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

PENTHORUM SEDOIDES L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SEDUM ACRE L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CROSSOSOMATACEAE

CROSSOSOMA BIGELOVII S. Wats.

An aqueous extract of the branches and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A chloroform extract was toxic to German cockroaches and webbing clothes moth and black carpet beetle larvae, but not to milkweed bugs and *Aedes* and *Anopheles* mosquito larvae. Alcohol and petroleum ether extracts were toxic only to black carpet beetle larvae. The same results were obtained with extracts of the stems and branches. A chloroform extract of the roots was toxic to German cockroaches and larvae of the webbing clothes moth and black carpet beetle. Chloroform extracts of the stems and of the bark were toxic to German cockroaches and black carpet beetle larvae.--Heal and coworkers (93).

CRUCIFERAE

ARMORACIA RUSTICANA (Lam.) Gaertn., Mey., & Scher. Synonym: *Nasturtium armoracia*. Horseradish.

Acetone and water extracts of the roots were nontoxic to mosquito larvae.--Hartzell (89).

BARBAREA VULGARIS R. Br. Bitter wintercress.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

BRASSICA CERNUA Thunb.

A water suspension of the leaves, stems, flowers, and roots was highly toxic to *Drosophila hydei* larvae.--Yamaguchi and coworkers (233).

BRASSICA HIRTA Moench. Synonyms: *B. alba, Sinapis alba*.

Acetone and water extracts of the seeds were nontoxic to mosquito larvae.--Hartzell (89).

BRASSICA NIGRA (L.) Koch.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BRASSICA RAPA L. Rape.

An acetone extract of rapeseed was nontoxic to mosquito larvae.--Hartzell (90).

Rapeseed oil was not very promising against San José scale.--Viel (216).

Rape oil soap was somewhat toxic to sugarcane wooly aphis.--Cheu (45).

CAMELINA SATIVA Crantz. Flax.

Flaxseed oil was not very promising against San José scale.--Viel (216).

CAPSELLA BURSA-PASTORIS (L.) Medic. Shepherd's purse.

Acetone and water extracts of the whole plant were nontoxic to mosquito larvae.--Hartzell (89).

CAULANTHUS CRASSICAULIS S. Wats.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CORONOPUS DIDYMUS (L.) Sm.

An aqueous extract of the whole plant was nontoxic to German and American cock-

roaches and milkweed bugs.--Heal and coworkers (93).

LEPIDIUM CAMPESTRE L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream.--Heal and coworkers (93).

LEPIDIUM VIRGINICUM L.

A water suspension of the leaves and stems was somewhat toxic to Drosophila hydei larvae, while a suspension of the roots was nontoxic.--Yamaguchi and coworkers (233).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

LESQUERELLA FENDLERI (Gray) Wats.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

PLUPARIA DIDYMOCARPA Gray.

An aqueous extract of the roots and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RAPHANUS ACANTHIFORMIS Morel.

Water suspensions of the leaves and flowers and of the leaves and stems were nontoxic to Drosophila hydei larvae, but a suspension of the roots was highly toxic to these larvae.--Yamaguchi and coworkers (233).

RORIPA NASTURTIUM-AQUATICUM (L.) Schinz & Thell. Synonym: Radicula nasturtium-aquaticum. Watercress.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

SISYMBRIUM OFFICINALE L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CUCURBITACEAE

BRANDEGEA BIGELOVII Cogn.

An aqueous extract of the stems and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A chloroform extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and petroleum ether extracts were nontoxic to all these insects.--Heal and coworkers (93).

BRYONIA ALBA L. Bryonia.

BRYONIA DIOICA Jacq.

An acetone extract of the roots was nontoxic to mosquito larvae.--Hartzell (90).

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BRYONIA VERRUCOSA Ait.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CAYOPONIA FICIFOLIA (Lam.) Cogn. Synonym: Trianosperma ficifolia.

An aqueous extract of the stems, leaves, and roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

CERATOSANTHES PALMATA Urban.

An aqueous extract of the roots was slightly toxic to American cockroaches and

nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CITRULLUS COLOCYNTHIS (L.) Schrad. Synonym: Cucumis colocynthis. Colocynth.

Acetone and water extracts of the fruit were nontoxic to mosquito larvae.--Hartzell (89).

A 10-percent emulsion of extracts of the fruit, used as a spray, had no effect on Triatoma infestans.--Wasicky and Unti (218).

CITRULLUS VULGARIS Schrad. Watermelon.

An acetone extract of the seeds was toxic to mosquito larvae, but a water extract was inactive. The acetone extract at 400 p.p.m. was ineffective against Aphis rumicis.--Hartzell (89).

COCCINIA CORDIFOLIA (L.) Cogn.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CORALLOCARPUS EMETOCATHARTICUS.

An aqueous extract of the stems and fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CUCUMIS MELO L. Cantaloupe, muskmelon, honeydew.

Acetone and water extracts of cantaloupe seeds were nontoxic to mosquito larvae. An acetone extract of honeydew seeds was toxic, but a water extract was ineffective against the larvae.--Hartzell (89).

CUCUMIS SATIVUS L. Cucumber.

An acetone extract of the seeds was toxic to mosquito larvae, but a water extract was ineffective against the larvae.--Hartzell (89).

CUCURBITA FOETIDISSIMA H. B. K. Buffalo gourd.

The powdered root was somewhat toxic to cabbage worm larvae. The seed oil had no toxicity to cucumber beetles and showed no synergistic effect with pyrethrins against this insect or adult house flies,--Jacobson (108).

An aqueous extract of the tubers was very toxic to American and German cockroaches, but an extract of the roots was only slightly toxic to the former and nontoxic to the latter and to milkweed bugs. An aqueous extract of the stems and leaves was toxic only to American cockroaches. A petroleum ether extract of the roots was toxic to milkweed bugs and black carpet beetle larvae, but not to German cockroaches, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Alcohol and chloroform extracts of the roots were toxic only to black carpet beetle larvae.--Heal and coworkers (93).

CUCURBITA MAXIMA Duchesne.

Acetone and water extracts of the seeds were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the seeds was only slightly toxic to American cockroaches.--Heal and coworkers (93).

CUCURBITA PALMATA S. Wats.

Aqueous extracts of the fruits, of the stems and leaves, and of the roots, were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol and petroleum ether extracts of the stems and leaves were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

CUCURBITA PEPO L.

An aqueous extract of the seeds was toxic to German cockroaches and slightly toxic to American cockroaches.--Heal and coworkers (93).

CUCURBITA PEPO var. OVIFERA (L.) Bailey. Pumpkin, gourd.

An acetone extract of the seeds was toxic to mosquito larvae, but a water extract was inactive.--Hartzell (89).

CUCURBITA sp. Squash.

An acetone extract of the seeds was toxic to mosquito larvae, but a water extract was inactive.--Hartzell (89).

ECHINOCYSTIS FABACEA Naud. Manroot, wild cucumber.

The powdered roots showed little or no toxicity to southern armyworms, melonworms, Hawaiian beet webworms, and cross-striped cabbage worms.--Bottger and Jacobson (36).

The powdered roots were toxic to European corn borer larvae. Petroleum ether, ethyl ether, chloroform, and alcohol extractives were all nontoxic to house flies and codling moth larvae.--Jacobson (108).

An aqueous extract of the tops was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ECHINOCYSTIS GILENSIS (S. Wats.) Greene.

An aqueous extract of the stems, leaves, and fruits was very toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ECHINOCYSTIS MACROCARPA Greene.

An aqueous extract of the roots and leaves was nontoxic to German and American cockroaches. An aqueous extract of the seeds was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ECHINOCYSTIS OREGANA (Torr. & Gray) Cogn. Synonym: Micrampelis oregana.

Aqueous extracts of the fruits and of the roots were toxic to American cockroaches but not to German cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts of the roots were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

FEVILLEA CORDIFOLIA L.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

IBERVILLEA LINDHEIMERI (Cogn.) Greene.

Aqueous extracts of the fruits and of the roots were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LUFFA ACUTANGULA (L.) Roxb.

Aqueous extracts of the seeds and of the whole plant were very toxic to American cockroaches but not to German cockroaches and milkweed bugs. A chloroform extract of the seeds was toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and Aedes mosquito larvae. A petroleum ether extract was toxic to black carpet beetle larvae only, while an alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

LUFFA AEGYPTIACA Mill. Synonym: L. cylindrica.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LUFFA sp.

Acetone and water extracts of the seeds were nontoxic to mosquito larvae.--Hartzell (89).

Aqueous extracts of the fruits and of the stems and roots were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MOMORDICA CHARANTIA L.

An aqueous extract of the leaves was very toxic to German and American cockroaches but not to milkweed bugs. An extract of the

grass was toxic to American cockroaches only. Alcohol and chloroform extracts of the whole plant were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

TRICHOSANTHES sp.

Acetone and water extracts of the seeds were nontoxic to mosquito larvae.--Hartzell (89).

TUMAMOCA MACDOUGALII Rose.

An aqueous extract of the tubers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CYCADACEAE

DIOON sp.

An aqueous extract of the seeds was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ZAMIA FURFURACEA Ait.

An aqueous extract of the tubers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ZAMIA sp.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CYPERACEAE

CAREX CLIVORUM Ohwi.

A water suspension of the leaves and stems was ineffective against Drosophila hydei larvae, but a suspension of the combined leaves, stems, and roots was toxic to these larvae.--Yamaguchi and coworkers (233).

CAREX SIDEROSTICTA var. GLABRA Ohwi.

Water suspensions of the leaves and roots and of the combined leaves, stems, and roots were ineffective against Drosophila hydei larvae, but a suspension of the leaves and stems was highly toxic to these larvae.--Yamaguchi and coworkers (233).

CAREX TORTA Boott.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

CYPERUS ARTICULATUS L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CYPERUS ODORATUS L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CYPERUS ROTUNDUS L.

Known in Costa Rica as "nutgrass" or "coqui", this plant is used to prepare a contact insecticide effective against grasshoppers and other insects.--Anonymous (19).

The powdered seedless flower heads, leaves, and tubers each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

An aqueous extract of the whole plant was toxic to German cockroaches, slightly toxic to American cockroaches, and nontoxic to milkweed bugs.--Heal and coworkers (93).

CYPERUS sp.

An aqueous extract of the rhizomes was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

KYLLINGA ODORATA H. B. K. Capim cheiroso.

An aqueous extract of one sample of the whole plant was very toxic to American cockroaches and nontoxic to German cock-

roaches and milkweed bugs. An extract of a second sample was only slightly toxic to American cockroaches and nontoxic to the other species.--Heal and coworkers (93).

CYRILLACEAE

CLIFTONIA MONOPHYLLA (Lam.) Sarg.

Aqueous extracts of the branchlets and leaves and of the roots were both slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. --Heal and coworkers (93).

CYRILLA RACEMIFLORA L.

An aqueous extract of the branchlets and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

DATISCACEAE

DATISCA GLOMERATA (Presl.) Baill.

A chloroform extract of the roots was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and petroleum ether extracts were nontoxic to all these insects. Extracts of the stems, leaves, and flowers were toxic only to black carpet beetle larvae.--Heal and coworkers (93).

DIAPENSIACEAE

GALAX ROTUNDIFOLIA

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

DICHAPETALACEAE

DICHAPETALUM CYMOSUM Engl.

Aqueous extracts of the whole plant and of the stems and leaves were nontoxic to German and American cockroaches. Alcohol, petroleum ether, and chloroform extracts of the whole plant were toxic to black carpet beetle larvae (the alcohol extract was also toxic to webbing clothes moth larvae) and nontoxic to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae.--Heal and coworkers (93).

DICHAPETALUM TOXICARIUM Baill.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts of the roots were toxic to black carpet beetle larvae. The petroleum ether extract was also toxic to webbing clothes moth larvae and nontoxic to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae. Alcohol and chloroform extracts of the fruits were toxic to black carpet beetle larvae. The alcohol extract was also toxic to webbing clothes moth larvae and nontoxic to the other insects. An alcohol extract of the branches and leaves was toxic only to black carpet beetle larvae.--Heal and coworkers (93).

TAPURA GUIANENSIS Aubl.

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

DILLENIACEAE

CURATELLA AMERICANA L.

An aqueous extract of the branches and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

DAVILLA RUGOSA Poir.

Aqueous extracts of the roots and of the stems and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DAVILLA sp.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

DILLENIA INDICA L.

An aqueous extract of the roots was nontoxic to German and American cockroaches

and milkweed bugs.--Heal and coworkers (93).

DOLIOCARPUS sp.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TETRACERA SESSILIFLORA Triana & Planch.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DIOSCOREACEAE

DIOSCOREA BULBIFERA L.

An aqueous extract of the tubers was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

DIOSCOREA MACROSTACHYA Benth. Wild yam.

An acetone extract of the roots was ineffective against mosquito larvae.--Jacobson (108).

DIOSCOREA POLYGONOIDES Humb. & Bonpl.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the tubers was nontoxic to German and American cockroaches.--Heal and coworkers (93).

DIOSCOREA TOKORO Makino.

An insecticide is prepared from an aqueous extract of the root, bentonite, and sodium ligninsulfonate. The active principle in the root is dioscin saponin or dioscorea sapotoxin.--Yokoyama (235).

DIOSCOREA TRIPHYLLA var. DUMETORUM (Kunth.) R. Knuth.

Aqueous extracts of the roots and of the stems and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DIOSCOREA sp. Cabeza de negro.

The powdered tubers from Mexico were nontoxic to variegated cutworms and European corn borers. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were very effective against codling moth larvae, but ineffective against house flies.--Jacobson (108).

An aqueous extract of the leaves of an unidentified species of Dioscorea was nontoxic to German and American cockroaches and milkweed bugs, but an extract of the tubers was highly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TAMUS EDULIS Lowe.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

DIPSACACEAE

DIPSACUS SYLVESTRIS Mill.

An aqueous extract of the tops was toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PTEROCEPHALUS DUMETORUM T. Coult.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DIPTEROCARPACEAE

ANCISTROCLADUS BARTERI S. Elliot.

Aqueous extracts of the stems and of the stems and leaves were nontoxic to German and American cockroaches and milkweed bugs. Extracts of the roots were very toxic to American cockroaches and nontoxic to the other insects. A petroleum ether extract of

the roots was toxic to black carpet beetle larvae, slightly toxic to milkweed bugs, confused flour beetles, and webbing clothes moth larvae, and nontoxic to German cockroaches and Aedes mosquito larvae. Alcohol and chloroform extracts of the roots were toxic to black carpet beetle larvae and nontoxic to the other species of insects.--Heal and coworkers (93).

SHOREA NEGROSENSIS Foxw. Red lanan.

The wood is very susceptible to termites. --Wolcott (225).

DROSERACEAE

DIONAEA MUSCIPULA L.

DROSERA FILIFORMIS Pursh.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

EBENACEAE

DIOSPYROS MARITIMA Blume. Kanomai.

Petroleum ether and acetone extractives of the bark were ineffective against mosquito larvae, but an ethyl ether extractive was toxic to these larvae.--Jacobson (108).

DIOSPYROS MULTIFLORA Blanco.

An aqueous extract of the fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

DIOSPYROS POEPPIGIANA A. DC.

Aqueous extracts of the fruits and of the wood and bark were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

DIOSPYROS VIRGINIANA L.

An aqueous extract of the bark was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ROYENA sp.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ELAEAGNACEAE

ELAEAGNUS UMBELLATA Thunb.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HIPPOPHAE sp.

Aqueous extracts of the fruits and of the branches and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ELAEOCARPACEAE

ARISTOTELIA CHILENSIS (Mol.) Stuntz.
Synonym: A. macqui.

Aqueous extracts of the bark and of the stems were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MUNTINGIA CALABURA L.

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Aqueous extracts of the branchlets and leaves and of the roots were nontoxic to all these insects.--Heal and coworkers (93).

VALLEA STIPULARIS L. f.

Aqueous extracts of the branches, of the branchlets and leaves, and of the roots were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ERICACEAE

AGAURIA SALICIFOLIA (G. Don) Hook. f.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the stem bark was nontoxic to all these insects.--Heal and coworkers (93).

AMPELOTHAMNUS PHILLYREIFOLIUS (Hook.) Small.

An aqueous extract of the leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ANDROMEDA POLIFOLIA L.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ARBUTUS TEXANA Buckl.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ARCTOSTAPHYLOS PUNGENS Gray.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ARCTOSTAPHYLOS UVA-URSI (L.) Spreng. Synonym: Uva-ursi procumbens. Uva-ursi.

An acetone extract of the leaves was ineffective against mosquito larvae.--Hartzell (90).

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BEFARIA RACEMOSA Vent.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CASSIOPE MERTENSIANA (Bong.) G. Don.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHAMAEDAPHNE CALYCULATA (L.) Moench.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHIOGENES HISPIDULA (L.) Torr. & Gray.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ENKIANTHUS CAMPANULATUS var. ALBIFLORUS Makino.

An aqueous extract of the branchlets, leaves, and young fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

EPIGAEA REPENS L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

EUBOTRYOIDES GRAYANA var. GLAUCINA (Koidz.) Hara.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

EUBOTRYOIDES GRAYANA var. OBLONGIFOLIA (Miq.) Hara.

Water suspensions of the leaves, stems, and seeds and of the leaves and stems were toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

An acetone extract of the leaves was toxic to Culex pipiens larvae. The toxicity was traced to the water-insoluble portion of the extract.--Yamaguchi and coworkers (232).

GAULTHERIA PROCUMBENS L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquito. Alcohol and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

GAULTHERIA SHALLON Pursh.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

GAULTHERIA sp.

An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

KALMIA ANGUSTIFOLIA L. Sheep laurel, calfkill, lambkill.

Acetone extracts of the stems, the roots, and the leaves were all ineffective against mosquito larvae.--Jacobson (108).

KALMIA LATIFOLIA L.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream. An extract of the stems was nontoxic to these insects.--Heal and coworkers (93).

KALMIA MICROPHYLLA (Hook.) Heller.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches.--Heal and coworkers (93).

LEDUM GLANDULOSUM Nutt.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

LEDUM GROENLANDICUM Oeder.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

LEUCOTHOE AXILLARIS (Lam.) Don.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LEUCOTHOE CATESBAEI Gray.

An aqueous extract of the branchlets and leaves was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A petroleum ether extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was toxic to black carpet beetle and webbing clothes moth larvae, but not to the other insect species.--Heal and coworkers (93).

LEUCOTHOE GRAYANA Maxim.

The leaves of this plant are used against rice weevils in Japan.--Miyajima and Takei (152).

LEUCOTHOE KEISKEI Miq.

A water suspension of the leaves, stems, and flowers was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

LOISELEURIA PROCUMBENS (L.) Desv.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LYONIA LIGUSTRINA (L.) DC.

LYONIA MARIANA (L.) D. Don.

Aqueous extracts of the branchlets and of the leaves of these species were both nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LYONIA LUCIDA (Lam.) K. Koch. Synonym: Desmothamnus lucidus.

Aqueous extracts of the branchlets, leaves, and flowers, of the branches, and of the leaves were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MONOTROPA UNIFLORA L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A

petroleum ether extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and webbing clothes moth larvae. An alcohol extract gave the same results and was, in addition, nontoxic to Aedes mosquito larvae, while a chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

PERNETTYA PROSTRATA var. PENTLANDII.

An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PERNETTYA PROSTRATA var. PURPUREA.

An aqueous extract of the stems, leaves, and fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PIERIS FLORIBUNDA (Pursh) Benth. & Hook.

An aqueous extract of the whole plant was very toxic to American cockroaches and milkweed bugs but nontoxic to German cockroaches. A petroleum ether extract was toxic to black carpet beetle and webbing clothes moth larvae, but not to German cockroaches, milkweed bugs, and Anopheles mosquito larvae. Alcohol and chloroform extracts were toxic to black carpet beetle larvae only. A chloroform extract of the leaves was toxic to German cockroaches and black carpet beetle larvae, but not to larvae of the webbing clothes moth and Aedes mosquito. A chloroform extract of the stems was toxic to webbing clothes moth larvae only.--Heal and coworkers (93).

PIERIS JAPONICA (Thunb.) D. Don. Asebi.

An acetone extract of the leaves was toxic to Culex pipiens larvae. The toxicity was traced to the water-soluble portion of the extract.--Yamaguchi and coworkers (232).

A mixture of 150 g. asebi (asebotin content 15.53 percent), 18.4 g. pyrethrum, and 75 g. soap, dissolved in 18 liters of water, was as effective as pyrethrum soap solution in killing Aphis and Stephanitis anbigus. This formulation saves 75 to 80 percent of pyrethrum.--Matsubara (136).

An aqueous extract of the branches and leaves was somewhat toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PIERIS OVALIFOLIA D. Don.

This plant is used as an insecticide in India.--Chopra and Badhwar (49).

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PYROLA PICTA J. E. Sm.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RHODODENDRON ARBORESCENS (Pursh) Torr. Synonym: Azalea arborescens.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RHODODENDRON CATAWBIENSE Michx.

An aqueous extract of the flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RHODODENDRON JAPONICUM (Gray) Suringar.

An aqueous extract of the flowers was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RHODODENDRON MACROPHYLLUM G. Don. Synonym: R. californicum.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

RHODODENDRON MAXIMUM L.

The powdered plant was ineffective against Mexican bean beetle larvae.--Hansberry and Clausen (86).

RHODODENDRON MOLLE (Blume) G. Don. Yellow azalea.

The dried flowers, which act as a stomach poison, are used as an insecticide in China.--Stepanek and Prien (201).

The powdered leaves and roots each showed fair toxicity to Mexican bean beetle larvae but had no effect on bean aphids. Alcohol and chloroform extracts of the leaves had no effect on silkworm larvae and bean aphids; acetone extracts had no effect on bean aphids. Alcohol extracts of the roots had no effect on silkworm larvae or bean aphids, and acetone, chloroform, petroleum ether, and carbon tetrachloride extracts of the roots were all ineffective against bean aphids.--Lee and Hansberry (129).

The pulverized dried flowers were found to be a contact and stomach poison. When treated with the ground flowers, insects were caused to vomit and rapidly became paralyzed. When applied as dusts or sprays, the powder was effective against certain species of lepidopterous larvae and pentatomids. The roots and leaves were not insecticidal.--Chiu and coworkers (48).

Acetone extracts of the flowers and of the roots showed no material insecticidal action against bean aphids and adult saw-toothed grain beetles. The powdered roots were only slightly toxic to diamondback moth larvae, but the powdered flowers were toxic to this insect.--Tattersfield and coworkers (209).

The powdered roots and leaves were nontoxic to bean plataspids, and water suspensions were nontoxic to China-grass butterfly larvae. Powdered flowers paralyzed, but did not kill, silkworm larvae, and were toxic to bean plataspids but not to striped flea beetles. Water suspensions of the flowers were quite toxic to bean plataspids and Cruciferous leaf beetles, but showed little toxicity to sugar-cane wooly aphids and China-grass butterfly larvae. The suspensions were not toxic to large cotton leaf rollers, yellow-back blister beetles, and Pieris raphae.--Chiu (47).

SARCODES SANGUINEA Torr.

An aqueous extract of the whole plant with fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

VACCINIUM OXYCOCCOS. Synonym: Oxycoccus quadripetalus.

A water suspension of the leaves, stems, and roots was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

ERIOCAULACEAE

ERIOCAULON DECANGULARE L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ERYTHROXYLACEAE

ERYTHROXYLON AREOLATUM L. False cocaine.

The wood is very resistant to termites.--Wolcott (225).

EUCOMMIACEAE

EUCOMMIA ULMOIDES Oliv.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EUPHORBIACEAE

ACALYPHA INDICA L.

ACALYPHA SONORAE.

Aqueous extracts of the whole plant were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

ACALYPHA RHOMBOIDEA Raf.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

AEXTOXICON PUNCTATUM Ruiz & Pavon.

An aqueous extract of the branches, bark, and leaves was nontoxic to German and American cockroaches. Extracts of the bark and of the fruits were nontoxic to these insects and to milkweed bugs.--Heal and coworkers (93).

ALCHORNEA CORDIFOLIA Muell. Arg.

An aqueous extract of the branches and leaves was toxic to American cockroaches when injected into the blood stream, but

German cockroaches and milkweed bugs were unaffected after immersion in the extract. Extracts of the roots and of the stems were nontoxic to all these insects.--Heal and coworkers (93).

ALCHORNEA LATIFOLIA Sw.

The wood is very susceptible to termites. --Wolcott (225).

ALCHORNEA SICCA (Blanco) Merr.

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

ALEURITES FORDII Hemsl. Tung tree.

Tung oil soap was somewhat toxic to sugarcane wooly aphis.--Cheu (45).

Acetone extracts of tung oil and of tung seeds were ineffective against mosquito larvae.--Hartzell (90).

An acetone extract of the inner shell of the nuts was nontoxic to mosquito larvae. An alcohol extract of the roots was ineffective against codling moth larvae.--Jacobson (108).

ALEURITES MOLUCCANA Willd.

An aqueous extract of the fruits was nontoxic to German and American cockroaches. --Heal and coworkers (93).

ALEURITES TRISPERMA Blanco.

The powdered bulbs, kernels, leaves, bark, and wood each showed little or no toxicity to melonworm and diamondback moth larvae, Diabrotica bivittata and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

ANDRACHNE CORDIFOLIA Muell. Arg.

An aqueous extract of the branchlets and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the roots was slightly toxic to American cockroaches only.--Heal and coworkers (93).

ANTHOSTEMA SENEGALENSE Juss.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of a second sample of branchlets and leaves was nontoxic to all these insects.--Heal and coworkers (93).

BERNARDIA MYRICAEFOLIA (Muell. Arg.) Benth. & Hook.

An aqueous extract of the branchlets was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BRIDELIA MICRANTHA Baill.

Aqueous extracts of the leaves and of the roots were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CLEISTANTHUS COLLINUS (Roxb.) Benth. & Hook.

Aqueous extracts of the fruits and of the stem bark were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CNIDOSCOLUS URENS (L.) Arthur.

The powdered green fruit, leaves, roots, and stems were each nontoxic to southern armyworms, but the powdered fruit was highly toxic to Hawaiian and southern beet webworms and showed some toxicity to melonworms and wooly bears. Petroleum ether and alcohol extracts of the leaves, roots, and stems were nontoxic to house flies but acetone extracts were toxic to these insects.--Sievers and coworkers (197).

COLLIGUAJA INTEGERRIMA Gill. & Hook.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CROTON CALIFORNICUS Muell. Arg.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CROTON CILIATO-GLANDULOSUS Ort.

An aqueous extract of the leaves was slightly toxic to American cockroaches.--Heal and coworkers (93).

CROTON ELEUTHERIA Wright. Cascarilla.

Acetone and water extracts of the bark were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the bark was nontoxic to German and American cockroaches. --Heal and coworkers (93).

CROTON FLAVENS L.

The plant is reported to be repellent to insects.--Sesseler and Spoon (193).

CROTON GARDNERI Muell. Arg.

An aqueous extract of the branchlets was toxic to American cockroaches when injected into the bloodstream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

CROTON NIVEUS Jacq.

Aqueous extracts of the bark and of the stems, leaves, bark, and roots were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. --Heal and coworkers (93).

CROTON SONORAE Torr.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CROTON TEXENSIS Muell. Arg.

Petroleum ether and chloroform extracts of the whole plant were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

CROTON TIGLIUM L. Purging tree, evergreen.

The seeds were effective against aphids and silkworms. The vesicant principle from the seed oil is very toxic to aphids.--Chiu (47).

An acetone extract of the seeds and the resin from the seeds were toxic to mosquito larvae.--Jacobson (108).

An aqueous extract of the leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

CROTON URUCURANA Baill.

An aqueous extract of the stems and bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CROTON sp. Concanapire.

An acetone extractive of the roots and stems from Venezuela was ineffective against mosquito larvae.--Jacobson (108).

DALEMBERTIA POPULIFOLIA Baill.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

DITAXIS GUATEMALENSIS (Muell. Arg.) Pax. & K. Hoffm.

An aqueous extract of the leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ELAEOPHORBIA DRUPIFERA (Thonn.) Stapf.

An aqueous extract of the branchlets and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

EREMOCARPUS SETIGERUS Benth. Turkey mullein.

The powdered plant was toxic to cross-striped cabbage worms but not to melonworms, southern armyworms, and striped blister beetles.--Bottger and Jacobson (36).

An acetone extract of the plant was nontoxic to house flies, and an acetone extract of the leaves was nontoxic to mosquito larvae. Petroleum ether, combined ethyl ether-chloroform, and alcohol extractives of the leaves were all toxic to German cockroaches but not to codling moth larvae.--Jacobson (108).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ERYTHROCOCCA ANOMALA Prain.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EUPHORBIA ADENOCHLORA Morr. & Decne. Synonym: Galarhoeus adenochlorus.

Water suspensions of the leaves and of the roots were nontoxic to Drosophila hydei larvae, but a suspension of the combined leaves and stems was highly toxic to these larvae.--Yamaguchi and coworkers (233).

EUPHORBIA CALYCINA N. E. Br. Candelabra euphorbia.

The plant is used as an insecticide in Tanganyika.--Vanderplank (211).

EUPHORBIA CARACASANA Boiss.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

EUPHORBIA COTINOIDES Miq.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

EUPHORBIA DENDROIDES L.

A drop of milky sap placed on the back of ants and bugs killed the insects in a few minutes. A 1:100 dilution of the sap also killed bugs. An aqueous extract of the leaves was effective against house flies and mosquitoes, as was the powdered leaf, but the extract was not effective against bugs. A dilute acetone extract of the leaves was very effective against bugs and house flies. An aqueous extract of the stems was effective against bugs.--Mülhens (154).

EUPHORBIA GENICULATA Ort.

An aqueous extract of the leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

EUPHORBIA HETEROPHYLLA L.

The powdered whole plant with roots showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

EUPHORBIA HIRTA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

EUPHORBIA INTISY. Intisy.

The seed oil was somewhat toxic to mosquito larvae.--Jacobson (108).

EUPHORBIA IPECACUANHAE L. Ipecac spurge.

An acetone extract of the roots was toxic to mosquito larvae.--Jacobson (108).

EUPHORBIA KHASYANA Boiss. Synonym: E. nematocypha.

The powdered roots showed fair toxicity to Mexican bean beetle larvae but little toxicity to silkworm larvae and bean aphids. An alcohol extract of the roots had no effect on silkworm larvae and bean aphids.--Lee and Hansberry (129).

The powdered roots were ineffective against bean aphids.--Chiu (47).

EUPHORBIA LANCIFOLIA Schlecht.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

EUPHORBIA MACULATA L.

An aqueous extract of the stems and leaves was toxic to milkweed bugs but not to German and American cockroaches.--Heal and coworkers (93).

EUPHORBIA PEKINENSIS Rupr. Synonym: Galarhoeus pekinensis.

EUPHORBIA SIEBOLDIANA Morr. & Decne. Synonym: Galarhoeus sieboldianus.

Water suspensions of the leaves and stems and of the roots of these species were

somewhat toxic to Drosophila hydei larvae. --Yamaguchi and coworkers (233).

EUPHORBIA SCHLECHTENDALII Boiss.

The resin was toxic to codling moth larvae.--Jacobson (108).

EUPHORBIA THYMIFOLIA L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An extract of the stems was toxic to German cockroaches only.--Heal and coworkers (93).

EUPHORBIA TIRUCALLI L.

Africans use the fresh branches to protect young plants from the ravages of grasshoppers, slugs, snails, and other insects. Young shoots laid around various vegetable plants gave complete protection against insects. Aqueous extracts of the fresh material had no effect on mosquito larvae but seemed to possess some insecticidal effect on adult Diptera. Extracts prepared by steeping 50 grams of young shoots, dried in an oven at 100°C., in 100 cc. kerosene for 48 hours gave 100 percent kill of adult mosquitoes. The same extract prepared from sun-dried shoots was ineffective.--Vanderplank (211).

The latex was ineffective against house flies.--Jacobson (108).

EUPHORBIA TRICHOTOMA H. B. K.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

EUPHORBIA sp.

Acetone and water extracts of the leaves and stems were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the branches was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Alcohol and petroleum ether extracts of the roots were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth (except the alcohol extract which was toxic) and Aedes and Anopheles mosquitoes. A chloroform extract of the roots was nontoxic to all these insects.--Heal and coworkers (93).

EXCOECARIA AFRICANA Muell. Arg.

An aqueous extract of the stem bark was toxic to American cockroaches and milkweed bugs but not to German cockroaches. --Heal and coworkers (93).

EXCOECARIA AGALLOCHA L.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

FLUGGEA LEUCOPYRUS Willd.

An aqueous extract of the stems was nontoxic to German and American cockroaches. --Heal and coworkers (93).

FLUGGEA MICROCARPA Blume.

An acetone extract of the bark was nontoxic to mosquito larvae.--Jacobson (108).

FLUGGEA VIROSA (Roxb.) Baill.

An acetone extract of the roots was nontoxic to mosquito larvae.--Jacobson (108).

GARCIA NUTANS Rohr. Pinoncillo.

Petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds were all nontoxic to house flies and codling moth larvae.--Jacobson (108).

GYMANTHES LUCIDA Sw.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HEVEA BRASILIENSIS (A. Juss.) Muell. Arg.

HEVEA SPRUCEANA Muell. Arg.

Aqueous extracts of the tips and young leaves of each of these species were nontoxic to German and American cockroaches. --Heal and coworkers (93).

HEVEA sp. Rubber tree.

Rubber seed oil was found to be an effective prophylactic against house flies.--Anonymous (25).

HIERONYMA ALCHORNEOIDES Allem. Zapatero.

The heartwood of this tree from Costa Rica was found to be moderately toxic to termites.--Scheffer and Duncan (191).

HIERONYMA CLUSEOIDES Griseb.

HIERONYMA LAXIFLORA Muell. Arg.

The wood is susceptible to termites.--Wolcott (225).

HIPPOMANE MANCINELLA L. Manzanillo.

The wood is very susceptible to termites.--Wolcott (225).

An acetone extract of the bark and burrs was somewhat toxic to mosquito larvae.--Jacobson (108).

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

HOMALANTHUS FASTUOSUS Villar.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

HURA CREPITANS L. Sandbox.

The wood is very susceptible to termites.--Wolcott (225).

The powdered green fruit was nontoxic to southern armyworms. The powdered leaves and ripe fruit were nontoxic to southern armyworms but somewhat toxic to cabbage loopers. The powdered roots were nontoxic to both of these insect species. The powdered stems were toxic to southern armyworms but not to cabbage loopers. Petroleum ether and acetone extracts of the green fruit and seeds were toxic to mosquito larvae but not to house flies. A petroleum ether extract of the ripe fruit was toxic to mosquito larvae but not to house flies. Petroleum ether extracts of the leaves and of the roots were toxic to mosquito larvae, but alcohol extracts were ineffective against these larvae.--Sievers and coworkers (197).

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

HURA POLYANDRA Baill. Habe, avilla tree.

The sap, diluted 1:10 and used as a contact spray, was moderately toxic to bean aphids.--Hansberry and Clausen (86).

Both the sap and an acetone extract of the seeds were very toxic to mosquito larvae.--Jocobson (108).

HYMENOCARDIA ACIDA Tul.

Aqueous extracts of the roots and of the leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

JATROPHA ANGUSTIDENS Muell. Arg.

An aqueous extract of the bark was very toxic to American cockroaches when injected into the blood stream, but milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of Aedes and Anopheles mosquitoes. The alcohol extract was toxic to larvae of the webbing clothes moth. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

JATROPHA CURCAS L.

Some parts of the plant were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the seeds was toxic to German and American cockroaches but nontoxic to milkweed bugs.--Heal and coworkers (93).

JATROPHA GOSSYPIFOLIA L.

Some parts of the plant were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

JATROPHA MACRORHIZA Benth.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was very toxic to American cockroaches but nontoxic to German cockroaches. Petroleum ether and chloroform extracts of the roots were toxic

to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* mosquito. An alcohol extract was nontoxic to all these insects. Alcohol, petroleum ether, and chloroform extracts of the seeds were toxic to black carpet beetle larvae, but nontoxic to all the other insects as well as to *Anopheles* mosquito larvae.--Heal and coworkers (93).

JATROPHA OLIGANDRA Muell. Arg.

An aqueous extract of the fruits was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the seeds was toxic to German cockroaches but not to American cockroaches and milkweed bugs. Petroleum ether and chloroform extracts of the fruits were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes. An alcohol extract of the fruits was nontoxic to all these insects.--Heal and coworkers (93).

JATROPHA PODAGRICA Hook.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

JOANNESIA PRINCEPS Vell.

An aqueous extract of the strip bark was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the seeds were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

MALLOTUS PHILIPPINENSIS (Lam.) Muell. Arg. Kamala.

Acetone and water extracts of the hairs of the capsules were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MANIHOT ANGUSTILOBA Muell. Arg.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream.--Heal and coworkers (93).

MERCURIALIS ANNUA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

OMPHALEA DIANDRA L.

An aqueous extract of the fruits was very toxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

OMPHALEA OLEIFERA Hemsl.

An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

OMPHALEA TRIANDRA L.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

OMPHALEA TRICHOTOMA Muell. Arg.

Aqueous extracts of the fruits and of the roots were nontoxic to German and American cockroaches and milkweed bugs. Extracts of the stems and leaves were toxic to American cockroaches only.--Heal and coworkers (93).

PEDILANTHUS TITHYMALOIDES Poit.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PETALOSTIGMA QUADRILOCULARE F. Muell.

An aqueous extract of the nut shells was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PHYLLANTHUS ACUMINATUS Vahl.

Some of the plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

As a stomach poison, the bark showed some toxicity to melonworm larvae and Andrector ruficornis adults, but it was ineffective against diamondback moth larvae. As a contact poison, the bark had some effect on Andrector and cotton stainer adults, but it was inert to melonworm larvae and Australian cockroach nymphs. The roots were highly toxic, as a stomach poison, to melonworm and diamondback moth larvae and Andrector adults, while, as a contact poison, the roots were toxic only to melonworm larvae, being inert to cotton stainer adults and Australian cockroach nymphs. The leaves and the wood showed some toxicity to melonworm larvae and cotton stainer adults, but were inert to Andrector adults and Australian cockroach nymphs.--Plank (174).

An aqueous extract of the branches, leaves, roots, and stems was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the leaves were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

PHYLLANTHUS BRASILIENSIS (Aubl.) Muell. Arg.

An aqueous extract of the leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

PHYLLANTHUS DIFFUSUS Klotsch.

Aqueous extracts of the leaves and of the stems were toxic to American cockroaches but not to German cockroaches. An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PHYLLANTHUS EMBLICA L.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PHYLLANTHUS ICHTHYOMETHIUS Rusby. Barbasco de hoja.

An acetone extract of the leaves was nontoxic to mosquito larvae.--Jacobson (108).

PHYLLANTHUS NIRURI L.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

PHYLLANTHUS POLYGONOIDES Spreng.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PIRANHEA TRIFOLIATA Baill.

An aqueous extract of the stem bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

REVERCHONIA ARENARIA Gray.

An aqueous extract of the stems, leaves, and fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

RICINUS COMMUNIS L. Castor bean plant.

Neither ricin nor ricinine was toxic to house flies.--Haller and McIndoo (84).

Extracts of the leaves and of the stalks were effective against dog and cat fleas, sticktight fleas, chicken lice, and mites.--VanOver (214).

"Spra Kast", a commercial product containing extractives of the leaves and stalks, is effective against most garden insects.--Anonymous (16).

Ricin was without effect, but ricinine was highly toxic to codling moth larvae.--Siegler and coworkers (196).

A review lists 52 published papers on the insecticidal uses of this plant.--McIndoo (145).

Powdered "Spra Kast" was nontoxic to southern armyworms, melonworms, Hawaiian beet webworms, bean leaf rollers, cross-striped cabbage worms, and European corn borers. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of this material were nontoxic to house flies and codling moth larvae.--Jacobson (108).

A 50-percent solution of castor oil in kerosene was ineffective as a repellent against Aedes mosquitoes.--McCulloch and Waterhouse (142).

Castor oil soap was somewhat toxic to the sugarcane wooly aphis.--Cheu (45).

SAPIUM BILOCULARE (S. Wats.) Pax. Yerba de flecha.

The powdered stems were nontoxic to southern armyworms, melonworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered stems were only slightly toxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the stems were nontoxic to house flies and codling moth larvae.--Jacobson (108).

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SAPIUM JAMAICENSE Sw.

An aqueous extract of the wood was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SAPIUM sp.

An aqueous extract of the branches and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

SEBASTIANA LONGICUSPIS Standl.

An aqueous extract of the roots, bark, and branches was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SPONDIANTHUS UGANDENSIS Hutchinson.

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

STILLINGIA SYLVATICA L. Queen's delight, stillingia.

An acetone extract of the root was nontoxic to mosquito larvae.--Hartzell (90).

An aqueous extract of an unidentified part of the plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

STILLINGIA TEXANA (Torr.) I. M. Johnston.

Both the powdered aerial portion and the powdered roots were nontoxic to southern armyworms, melonworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered aerial portion and the powdered roots were nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the aerial portion were nontoxic to house flies but toxic to codling moth larvae, while combined extractives of the roots were nontoxic to both these insect species.--Jacobson (108).

TRAGIA VOLUBILIS L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

FAGACEAE

QUERCUS ALBA L. White oak.

The heartwood was moderately resistant to termites.--Scheffer and Duncan (191).

The wood is susceptible to termites.--Wolcott (225).

QUERCUS COPEYENSIS C. H. Mull. Roble, encino.

The heartwood was moderately resistant to termites.--Scheffer and Duncan (191).

QUERCUS INFECTORIA Oliv. Aleppo nutgalls.

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

QUERCUS RUBRA L. Synonym: Q. borealis. Red oak.

The wood is very susceptible to termites.--Wolcott (225).

QUERCUS VELUTINA Lam. Synonym: Q. tinctoria. Black oak.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

QUERCUS sp.

An acetone extract of the bark was ineffective against mosquito larvae.--Hartzell (90).

FLACOURTIACEAE

ANCISTROTHYRSUS TESSMANNII Harms.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

APHLOIA THEAEFORMIS Benn.

Aqueous extracts of the roots and of the stem bark were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ARECHAVALETAIA URUGUAYENSIS Speg.

An aqueous extract of the roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

AZARA GILLIESII Hook. & Arn.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BYRSANTHUS BROWNII Guillem.

Aqueous extracts of the roots and of the stems were nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the stems and leaves was slightly toxic to American cockroaches only.--Heal and coworkers (93).

CARPOTROCHE AMAZONICA Mart.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CASEARIA BRASILIENSIS Eichl.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CASEARIA COMMERSONIANA Cambess.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CASEARIA JAVITENSIS H. B. K.

Aqueous extracts of the bark and of the flower heads were nontoxic to German and American cockroaches and milkweed bugs. An extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CASEARIA MACROPHYLLA Vahl.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CASEARIA RESINIFERA Spruce.

An aqueous extract of the roots was toxic to German cockroaches but not to American cockroaches.--Heal and coworkers (93).

CASEARIA TOMENTOSA Roxb.

An aqueous extract of the bark and seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CASEARIA sp.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An extract of the stems was slightly toxic to American cockroaches only.--Heal and coworkers (93).

FLACOURTIA CATAPHRACTA Roxb.

An aqueous extract of the roots and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

GOSSYPIOSPERMUM PRAECOX (Griseb.) P. Wils.

An aqueous extract of the roots, leaves, and branches was nontoxic to German and American cockroaches.--Heal and coworkers (93).

GYNOCARDIA ODORATA R. Br.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs. Alcohol and petroleum ether extracts of the seeds were toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae. A chloroform extract was toxic to black carpet beetles only.--Heal and coworkers (93).

HOMALIUM RACEMOSUM Jacq. Tostado.

The wood is resistant to termites.--Wolcott (225).

HOMALIUM sp.

An aqueous extract of the roots was nontoxic to German and American cockroaches. An extract of the root bark was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

LAETIA CALOPHYLLA Eichl.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches. Petroleum ether and chloroform extracts of the stems and roots were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

ONCOBA ECHINATA Oliver.

ONCOBA SPINOSA Forsk.

Aqueous extracts of the roots of each of these species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RAWSONIA USAMBARENSIS Engl.

Aqueous extracts of the root wood and of the stem wood were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RYANIA ANGUSTIFOLIA (Turcz.) Monachino.

An aqueous extract of the roots was slightly toxic to American cockroaches. A chloroform extract was toxic to German cockroaches but not to milkweed bugs. A chloroform extract of the stems was toxic to webbing clothes moth and black carpet beetle larvae, and nontoxic to Aedes mosquito larvae.--Heal and coworkers (93).

RYANIA SPECIOSA Vahl. Synonym: R. pyrifera.

The following are some of the many published reports on the toxicity of this plant to various insect species.

The powdered stems and roots were effective in the control of the European corn borer.--Pepper and Carruth (170).

The use of this and of other species of Ryania as insecticides has been patented.--Folkers and coworkers (67).

The effect of the powdered stems and roots was comparable to that of DDT in reducing twig-infesting larvae of the oriental fruit moth.--Wheeler and LaPlante (225).

The powdered stems and roots were effective against the soybean caterpillar. A 50-percent dust applied at the rate of 25 pounds per acre increased the yield of soybean crops.--Kulash (122).

The powdered stems and roots were ineffective in the control of pear psylla.--Hamilton (85).

Ryanodine, an alkaloid isolated from an aqueous extract of the roots or a chloroform extract of the stems, was highly toxic to insects, being approximately 700 times as potent as the stem wood.--Rogers and coworkers (186).

A 0.02 percent solution of ryanodine was toxic immediately, and repellent for 4 months to the West Indian dry-wood termite (Cryptotermes brevis).--Wolcott (227).

Mixtures containing 7.5 percent and 15 percent of Ryania plus 0.5 percent of piperonyl cyclonene or n-propyl isome gave control of the European corn borer comparable to the standard 40 percent Ryania and to DDT and parathion.--Reed and Filmer (183).

Susceptible woods treated with 0.01 percent of Ryania extractive were toxic to the West Indian dry-wood termite for 204 days. When a 0.05 percent solution was used, the wood was not definitely eaten in 18 months. --Wolcott (228).

Ryanodine was 70 times more toxic to male and female German cockroaches than were aqueous extracts of the roots or stems. It was many times more effective than the extracts against webbing clothes moth larvae.--Rogers (185).

The powdered roots were toxic to southern armyworms and melonworms, but not to variegated cutworms.--Bottger and Jacobson (36).

The powdered roots were toxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the roots were effective against codling moth larvae but not against adult house flies. A 10-percent talc dust of an aqueous extractive of the roots was toxic to southern armyworms, melonworms, imported cabbage worms, Autographa 00, and squash bugs, but nontoxic to blister beetles. A kerosene spray of the extractive was nontoxic to house flies, but an acetone spray was quite toxic to this insect. Aqueous and acetone solutions of the extractive were repellent to black carpet beetle larvae. The powdered roots were very effective against European corn borers, somewhat less effective against mosquito larvae, and ineffective against house flies, adult body lice, and the louse eggs.--Jacobson (108).

Aqueous extracts of the roots and of the stems were highly toxic to German and American cockroaches. A chloroform extract of the stems was toxic to German cockroaches, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito, but nontoxic to milkweed bugs and Anopheles mosquito larvae. A chloroform extract of the roots was toxic to German cockroaches. A chloroform extract of the bark was toxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle and webbing clothes moth.--Heal and coworkers (93).

RYANIA SPECIOSA var. STIPULARIS (Linden & Planch.) Monachino.

A chloroform extract of the roots was toxic to webbing clothes moth larvae.--Heal and coworkers (93).

RYANIA SPECIOSA var. SUBULIFLORA (Sandw.) Monachino.

The plant is used as an insecticide in British Guiana.--Fanshawe (60).

An aqueous extract of the roots was toxic to German and American cockroaches. A chloroform extract was toxic to German cockroaches. An alcohol extract of the bark was toxic to German cockroaches.--Heal and coworkers (93).

RYANIA SPECIOSA var. TOMENTOSA (Miq.) Monachino.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches. A chloroform extract was toxic to German cockroaches and webbing clothes moth larvae. A chloroform extract of the leaves was nontoxic to milkweed bugs and webbing clothes moth larvae.--Heal and coworkers (93).

RYANIA sp.

A mixture of a carrier and the ground stems, leaves, roots, etc. of Ryania species, which is active against European maize borers, has been patented. A water suspension of the plant part may also be used.--Folkers and coworkers (68).

The powdered dried roots, stems, and leaves of Ryania species, in an inert base, is effective as a dust or spray against apple aphids, potato aphids, squash bugs, milkweed bugs, onion thrips, Japanese beetles, elm-leaf beetles, Mexican bean beetles, asparagus beetles, Colorado potato beetles, golden tortoise beetles, yellow meal worms, imported cabbage worms, cabbage loopers, diamondback moths, corn earworms, and silkworms.--Heal (92).

SAMYDA PUBESCENS Blanco.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SAMYDA SPINULOSA Vent.

An aqueous extract of the branchlets and leaves was slightly toxic to American cock-

roaches and nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the roots was very toxic to American cockroaches only. A petroleum ether extract of the roots was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and webbing clothes moth larvae. Alcohol and chloroform extracts of the roots were nontoxic to all these insects as well as to Aedes mosquito larvae.--Heal and coworkers (93).

TARAKTOGENOS KURZII. Synonym: Hydnocarpus kurzii.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TRIMERIA BAKERI Gilg.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

XYLOSOMA sp.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ZUELANIA GUIDONIA (Sw.) Britton & Millsp.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

FLAGELLARIACEAE

FLAGELLARIA GUINEENSIS Schum.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

FOUQUIERIACEAE

FOUQUIERIA SPLENDENS Engelm.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

FRANKENIACEAE

FRANKENIA ERICIFOLIA C. Sm.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

FRANKENIA GRANDIFOLIA Cham. & Schlecht.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

FUMARIACEAE

CORYDALIS CRYSTALLINA Engelm.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DICENTRA CUCULLARIA (L.) Bernh. Synonym: Bicuculla cucullaria.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

DICENTRA FORMOSA Walp. Synonym: Bicuculla formosa.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

FUMARIA OFFICINALIS L. Fumatory herb.

Acetone and water extracts of the whole plant were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GENTIANACEAE

CENTAURIUM UMBELLATUM Gilib. Synonym: Erythraea centaurium.

Aqueous extracts of the stems and flowers and of the whole plant were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHELONANTHUS CHELONOIDES (L.f.) Gilg.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHIRONIA TRANSVAALENSIS Gilg.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COUTOUBEA RAMOSA Aubl.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

FRASERA PARRYI Torr.

An aqueous extract of the roots was nontoxic to German and American cockroaches. --Heal and coworkers (93).

IXANTHUS VISCOSUS Griseb.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SWERTIA CHIRATA Buch. Ham. Chiretta.

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

TACHIA GUIANENSIS Aubl.

An aqueous extract of the branchlets was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GERANIACEAE

ERODIUM CICUTARIUM (L.) L'Hér.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

GERANIUM ERIOSTEMON var. ONOEI Nakai.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

GERANIUM MACULATUM L. Cranesbill.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

PELARGONIUM CRISPUM L'Hér. Lemon geranium.

Acetone and water extracts of the leaves were ineffective against mosquito larvae.--Hartzell (89).

PELARGONIUM HORTORUM var. POITEVINE Hort.

Aqueous extracts of the flowers, the leaves, and the stems were all nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PELARGONIUM ODORATISSIMUM Ait. Rose geranium, nutmeg geranium.

An alcohol fraction prepared from oil of rose geranium removed 100 percent of ascarids, 97 percent of hookworms, and 40 percent of whipworms from dogs.--Jones and Jones (113).

PELARGONIUM ZONALE L'Hér. Geranium.

Acetone and water extracts of the leaves were ineffective against mosquito larvae.--Hartzell (89).

PELARGONIUM sp.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GINKGOACEAE

GINKGO BILOBA L. Ginkgo tree

Petroleum ether, ethyl ether, and alcohol extractives of the seeds were ineffective against codling moth larvae.--Jacobson (108).

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

GLOBULARIACEAE

GLOBULARIA ARABICA Jaub. & Spach.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GLOBULARIA SALICINA Lam.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GNETACEAE

EPHEDRA TRIFURCA Torr.

An aqueous extract of the branchlets and eaves was nontoxic to German and Amerian cockroaches and milkweed bugs.--Heal nd coworkers (93).

PHEDRA sp.

An acetone solution of the alkaloid, phedrine, was ineffective against mosquito rvae.--Hartzell (89).

NETUM SCANDENS Roxb.

An aqueous extract of the leaves was ightly toxic to American cockroaches and ontoxic to German cockroaches.--Heal and oworkers (93).

GOMORTEGACEAE

GOMORTEGA NITIDA Ruiz & Pavon.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GRAMINEAE

AGROSTIS PALUSTRIS Huds. Red top.

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

ANDROPOGON sp.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AVENA SATIVA L. Oat.

An acetone extract of the seeds was toxic to mosquito larvae.--Hartzell (90).

BAMBUSA VULGARIS Schrad. Bamboo.

The wood is very susceptible to termites.--Wolcott (225).

BROMUS CATHARTICUS Vahl.

An aqueous extract of the tops was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CATABROSA AQUATICA (L.) Beauv.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CHLORIS DISTICHOPHYLLA Lag.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CTENIUM AROMATICUM (Walt.) Wood.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CYMBOPOGON CITRATUS (DC.) Stapf. Lemon grass.

The plant juices are rubbed on exposed parts in El Salvador to repel mosquitoes and fleas.--Wellman and van Severen (221).

The plant is used as a mosquito repellent in the Philippines.--Quisumbing (179).

CYMBOPOGON FLEXUOSUS (Nees) Stapf. Lemon grass.

The plant repels the tsetse fly.--Alluand (11).

CYMBOPOGON NARDUS (L.) Rendle. Citronella.

Citronella grass repels the tsetse fly.--Alluand (11).

Ceylon citronella oil was very repellent to the sheep blowfly when tested as a 10-percent liquid paraffin dilution. The effectiveness diminished fairly rapidly when the material was exposed to the air. Of the constituents of the oil, borneol was fairly repellent, and citronellol, camphene, geranyl acetate, limonene, and dipentene each had a little repellency. Geraniol showed no repellent action. None of the constituents showed as great a repellent action as did the whole oil itself.--Mackerras and Mackerras (134).

Used in skin ointments, oil of citronella offers protection against mosquitoes and other insects.--Higbee (94).

Citronella oil attracts male fruit flies only.--Trehan and Pingle (210).

Java citronella oil is used to control head lice.--Loosjes (133).

Ceylon citronella oil was repellent to Aedes mosquitoes but not to Anopheles mosquitoes. The Java oil was completely inactive. Both citronellal and citronellol were ineffective as repellents against Aedes mosquitoes. The ceylon oil repelled the sheep blowfly but not the bush fly Musca vetustissima.--McCulloch and Waterhouse (142).

Ceylon citronella oil was repellent to the Australian sheep blowfly, but the Java oil was ineffective. Geraniol and citronellal were also ineffective.--Waterhouse (220).

A mixture containing 10 parts peanut oil, 18 parts stearic acid, 4 parts citronella oil, 16 parts pyrethrum extract, 0.5 part tragacanth, and a stabilizer and preservative is used in India as a mosquito repellant.--Siddiqui (194).

Methyl eugenol is a powerful attractant for male Oriental fruit flies. Methyl isoeugenol and Ceylon citronella oil are also good attractants but are much less effective. --Stainer (199).

DACTYLOCTENIUM AEGYPTIUM (L.) Beauv.

An aqueous extract of the whole plant was toxic to German and American cockroaches but not to milkweed bugs.--Heal and coworkers (93).

DIGITARIA SANGUINALIS var. CILIARIS (Retz.) Pavl.

An acetone extract of the whole plant was nontoxic to Culex pipiens larvae.--Yamaguchi and coworkers (232).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ELYONURUS ARGENTEUS Nees.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ERAGROSTIS CILIANENSIS (All.) Lut.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. A petroleum ether extract was nontoxic to all these insects.--Heal and coworkers (93).

GUADUA LATIFOLIA Kunth. Ecuadorean giant bamboo.

The wood is very susceptible to termites.--Wolcott (225).

LOLIUM TEMULENTUM L.

Aqueous extracts of the whole plant and of the flowering spikes were nontoxic to

German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MELINIS MINUTIFLORA Beauv. Molasses grass, snakeproof grass.

The plant is reported to be repellent to ticks, mosquitoes, ants, tsetse flies, chiggers, and snakes.--Anonymous (15).

The powdered grass was nontoxic to southern armyworms, melonworms, southern beet webworms, European corn borers, black carpet beetle larvae, and adult body lice. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives, as well as an acetone extractive, were ineffective against screwworms, body lice, and house flies, but effective against codling moth larvae. Neither a petroleum ether extractive of the fresh grass nor a water-soluble fraction which separated therefrom were repellent to Aedes aegypti mosquitoes.--Jacobson (108).

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were ineffective against German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes. A chloroform extract was ineffective against German cockroaches, milkweed bugs, and Aedes mosquito larvae.--Heal and coworkers (93).

ENNISETUM NERVOSUM (Nees) Trin.

An aqueous extract of the whole plant is toxic to American cockroaches when jected into the blood stream, but German ckroaches and milkweed bugs were unected after immersion in the extract.--al and coworkers (93).

A PRATENSIS L. Kentucky blue grass.

An acetone extract of the whole plant s ineffective against mosquito larvae.--rtzell (90).

IBATAEA KUMASASA (Zoll.) Makino.

water suspension of the leaves and ms was highly toxic to Drosophila hydei vae.--Yamaguchi and coworkers (233).

ANION HYSTRIX (Nutt.) J. G. Sm.

n aqueous extract of the whole plant nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SORGHUM HALEPENSE (L.) Pers. Johnson grass.

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

Aqueous extracts of the whole plant and of the stems and leaves were nontoxic to German and American cockroaches.--Heal and coworkers (93).

SORGHUM SUDANENSE (Piper) Stapf.

An aqueous extract of the seeds was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SORGHUM VULGARE

An acetone extract of the seeds was ineffective against mosquito larvae.--Hartzell (90).

STIPA ROBUSTA (Vasey) Scribn.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

VETIVERIA ZIZANIOIDES (L.) Nash. Khus-khus grass, vetiver.

The roots are used to ward off clothes moths and to kill plant lice and bedbugs.--Higbee (94).

An acetone extractive of the roots was ineffective against mosquito larvae.--Jacobson (108).

An aqueous extract of a sample of the roots was toxic to German cockroaches but not to American cockroaches. An extract of a second sample of the roots was toxic to American cockroaches and milkweed bugs, but not to German cockroaches. An extract of the tops was nontoxic to all these insects. A petroleum ether extract of the tops was toxic to black carpet beetles but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts of the tops were nontoxic to all these insects as well as to Aedes mosquito larvae.--Heal and coworkers (93).

ZEA MAYS L. Corn, maize.

Crude corn oil was equal to or superior to petroleum oil against oyster-shell scale, Mexican mealybugs, and willow scurfy scale. Refined corn oil was less effective.--Cressman and Dawsey (51).

HAEMODORACEAE

LACNANTHES TINCTORIA (Walt.) Ell.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

XIPHIDIUM COERULEUM Aubl.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HALORAGACEAE

MYRIOPHYLLUM SPICATUM L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PROSERPINACA PECTINATA Lam.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HAMAMELIDACEAE

HAMAMELIS VIRGINIANA L. Witch hazel.

An acetone extract of the bark was ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

LIQUIDAMBAR STYRACIFLUA L.

The wood is very susceptible to termites.--Wolcott (225).

PARROTIA PERSICA C. A. Mey.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HERNANDIACEAE

HERNANDIA SONORA L.

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HIPPOCASTANACEAE

AESCULUS CALIFORNICA Nutt. California buckeye.

Tests of flours made with the meat hulls of the nuts showed toxicity to larvae and adults of the Mexican bean beetle.--Apple and Howard (27).

AESCULUS GLABRA Willd.

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the fruits was nontoxic to German and American cockroaches.--Heal and coworkers (93).

AESCULUS HIPPOCASTANUM L.

An aqueous extract of the bark was toxic to American cockroaches, but an extract of the branchlets and leaves was only slightly toxic to these insects. An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

AESCULUS PAVIA L. Dwarf buckeye, red buckeye.

The flowers attract and kill Japanese beetles.--Anonymous (13).

An aqueous infusion of the roots showed toxicity to cattle grubs as a wash. When injected into grub cysts on the backs of cattle, it was quite toxic to the grubs.--Jacobson (108).

HIPPOCRATEACEAE

HEMIANGIUM EXCELSUM (H. B. K.) A. C. Sm.

Aqueous extracts of the fruits and of the leaves were nontoxic to German and American cockroaches.--Heal and coworkers (93).

PRISTIMERA CELASTROIDES (H. B. K.) A. C. Sm.

A paste of the seeds is used extensively in Latin America to kill human-body parasites. Both the powdered leaves and the powdered stems were toxic to southern beet webworms but not to southern armyworms and melonworms.--Bottger and Jacobson (36).

The powdered leaves and the powdered stems were ineffective against European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the leaves and of the stems were nontoxic to house flies and body lice, although the stem extractives were effective against codling moth larvae.--Jacobson (108).

Aqueous extracts of the seeds and of the stems, leaves, and flowers were nontoxic to American cockroaches. An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HUMERIACEAE

HUMIRIA BALSAMIFERA Jaume St. Hil.

The wood is resistant to termites.--Wolcott (225).

HUMIRIA FLORIBUNDA Mart.

SACCAGLOTTIS GABONENSIS Urban.

Aqueous extracts of the roots were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HYDROCARYACEAE

TRAPA NATANS L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HYDROCHARITACEAE

ELODEA DENSA Casp.

An aqueous extract of the stems and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

HYDROPHYLLACEAE

ELLISIA NYCTALEA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ERIODICTYON CALIFORNICUM (Hook. & Arn.) Greene.

Aqueous extracts of the whole plant and of the roots were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ERIODICTYON TRICHOCALYX Heller.

An aqueous extract of the leaves was toxic to German cockroaches and slightly toxic to American cockroaches.--Heal and coworkers (93).

HYDROPHYLLUM VIRGINIANUM L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

NAMA DEMISSUM Gray. Synonym: Marilaunidium demissum.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

NAMA JAMAICENSE L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PHACELIA GRANDIFLORA Gray.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

WIGANDIA CARACASANA H. B. K.

An aqueous extract of the branches, leaves, and fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HYPERICACEAE

CALOPHYLLUM ANTILLANUM Britton.

The wood is very susceptible to termites.--Wolcott (225).

The powdered seed hulls showed little or no toxicity to melonworm, fall armyworm, and diamondback moth larvae, and to bean leaf beetle adults. The powdered seed kernels, leaves, bark, and wood each showed little or no toxicity to these insects and to rice weevil adults. The powdered roots were ineffective against melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CALOPHYLLUM BRASILIENSE Cambess.

The wood is susceptible to termites.--Wolcott (226).

CALOPHYLLUM INOPHYLLUM L.

The powdered seeds and hulls showed little or no toxicity to several species of insects.--Plank (173).

The powdered seed hulls and kernels showed little or no toxicity to melonworm, fall armyworm, and diamondback moth larvae, Diabrotica bivittata and cotton stainer adults, and American cockroach nymphs. The powdered leaves, bark, wood, and roots each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

An aqueous extract of the bark was nontoxic to German and American cockroaches. An extract of the fruits was nontoxic to these insects and to milkweed bugs.--Heal and coworkers (93).

CARAIPA DENSIFLORA Mart.

An aqueous extract of the resin was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CARAIPA FASCICULATA Cambess.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GARCINIA SPICATA Hook. f.

An aqueous extract of the seeds was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HARONGA MADAGASCARIENSIS Chois.

Aqueous extracts of the branches and leaves and of the roots were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HYPERICUM CONCINNUM Benth.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

HYPERICUM PERFORATUM L.

An aqueous extract of the upper parts was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

OCHROCARPOS AFRICANUS Oliv.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract was toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and confused flour beetles. An alcohol extract was toxic only to black carpet beetle larvae.--Heal and coworkers (93).

PENTADESMA BUTYRACEA Sabine.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs. Alcohol and petroleum ether extracts were nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

PLATONIA INSIGNIS Mart.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

PSOROSPERMUM FEBRIFUGUM Spach.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

HEEDIA ARISTATA Griseb.

Aqueous extracts of the bark, of the branches and leaves, and of the roots were all nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract of the fruits was toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and Anopheles mosquito larvae. A petroleum ether extract of the bark was toxic to milkweed bugs only, while an alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

HEEDIA VERTICILLATA Urban.

HEEDIA sp.

Aqueous extracts of the branches and leaves of each species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SYMPHONIA GLOBULIFERA L. f.

An aqueous extract of the wood was nontoxic to German and American cockroaches.--Heal and coworkers (93).

VISMIA LEONENSIS Hook. f.

Aqueous extracts of the roots, of the stems, and of the stems and leaves were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ICACINACEAE

APODYTES DIMIDIATA E. Mey.

Aqueous extracts of the branches and leaves and of the roots were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

CHLAMYDOCARYA CAPITATA Baill.

Aqueous extracts of the roots, stems, and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

VILLARESIA CHILENSIS (Mol.) Stuntz.
Synonym: V. mucronata.

VILLARESIA CONGONHA Miers.

Aqueous extracts of the branches and leaves of these species were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

ILLECEBRACEAE

DICHERANTHUS PLOCAMOIDES Webb.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HERNIARIA GLABRA var. SUBCILLIATA.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German

cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PARONYCHIA MICROPHYLLA Phil.

PARONYCHIA SESSILIFLORA Nutt.

Aqueous extracts of the stems of P. microphylla and of the whole plant of P. sessiliflora were only slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PENTACAENA RAMOSISSIMA Hook & Arn.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

IRIDACEAE

ALOPHIA PULCHELLA (Sweet) Benth. & Hook.

An aqueous extract of the bulbs was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

BELAMCANDA CHINENSIS (L.) DC.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An extract of the rootstocks was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

GLADIOLUS sp.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the corms and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

HOMERIA COLLINA Vent.

An aqueous extract of the bulbs was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

IRIS FLORENTINA L. Florentine orris.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

IRIS SETOSA Pall.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

IRIS VERNA L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

IRIS sp.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SISYRINCHIUM ANGUSTIFOLIUM Mill.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

SISYRINCHIUM JUNCEUM E. Mey.

SISYRINCHIUM sp.

Aqueous extracts of these species were both toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

JUGLANDACEAE

CARYA GLABRA (Mill.) Sweet. Synonym: Hicoria glabra. Pignut hickory.

The wood is very susceptible to termites.--Wolcott (225).

An aqueous extract of the leaves was nontoxic to American cockroaches.--Heal and coworkers (93).

JUGLANS CINEREA L. Butternut.

The wood is susceptible to termites.--Wolcott (225).

An acetone extract of the leaves was ineffective against mosquito larvae.--Hartzell (90).

JUGLANS NIGRA L. Black walnut.

The wood is susceptible to termites.--Wolcott (225).

Acetone and water extracts of the bark were ineffective against mosquito larvae.--Hartzell (89).

The odor of the leaves is repellent to insects.--Aries (28).

Acetone extracts of the bark and of the roots were ineffective against mosquito larvae.--Hartzell (90).

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream. A chloroform extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and webbing clothes moth larvae. An alcohol extract was nontoxic to these insects as well as to Aedes and Anopheles mosquito larvae.--Heal and coworkers (93).

PTEROCARYA STENOPTERA DC.

The powdered leaves showed fair toxicity to Mexican bean beetle larvae. An alcohol extract had no effect on silkworm larvae and bean aphids, and chloroform and acetone extracts had no effect on bean aphids.--Lee and Hansberry (129).

The powdered root bark was nontoxic to bean aphids.--Chiu and coworkers (48).

JUNCACEAE

JUNCUS EFFUSUS L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

JUNCAGINACEAE

TRIGLOCHIN MARITIMA L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

KRAMERIACEAE

KRAMERIA GRAYI Rose and Painter.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

KRAMERIA TRIANDRA Ruiz & Pavon.

An aqueous extract of fragments of this plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

KRAMERIA sp.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LABIATAE

AGASTACHE FOENICULUM (Pursh) Kuntze.

An aqueous extract of the upper parts was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AGASTACHE URTICIFOLIA (Benth.) Kuntze.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

AJUGA BRACTEOSA Benth.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

AJUGA NIPPONICA Makino.

An aqueous suspension of the leaves and flowers was nontoxic to Drosophila hydei larvae, but a suspension of the combined leaves, stems, and roots was toxic to these larvae.--Yamaguchi and coworkers (233).

BYSTROPOGON CANARIENSIS L'Hér.

CLINOPODIUM VULGARE L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

COLEUS AMBOINICUS Lour.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COLLINSONIA ANISATA Sims.

A petroleum ether extract of the leaves was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito.--Heal and coworkers (93).

COLLINSONIA CANADENSIS L.

An aqueous extract of the leaves was nontoxic to American and German cockroaches.--Heal and coworkers (93).

CUNILA ORIGANOIDES (L.) Britton. Dittany herb.

Acetone and water extracts of the whole plant were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CUNILA sp.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GLECOMA HEDERACEA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the herbs was slightly toxic to American cockroaches and nontoxic to the other insect species.--Heal and coworkers (93).

HEDEOMA HISPIDA Pursh.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HEDEOMA MEDIA Epling.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HEDEOMA PULEGIODES (L.) Pers. Pennyroyal.

An aqueous extract of the leaves was toxic to German and American cockroaches. An extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Alcohol and petroleum ether extracts of the whole plant were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

HOSLUNDIA OPPOSITA Vahl.

An aqueous extract of the tops and flowers was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Aqueous extracts of the roots and of the stems were nontoxic to all these insects.--Heal and coworkers (93).

HYPTIS EMORYI Torr.

An aqueous extract of the stems, leaves, and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HYPTIS PECTINATA Poit.

An aqueous extract of the stems and leaves was toxic to American cockroaches.--Heal and coworkers (93).

HYPTIS RADIATA Willd.

An aqueous extract of the stems and flower heads was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HYPTIS RHYTIDEA Benth.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches.--Heal and coworkers (93).

HYPTIS SUAVEOLENS Poit.

The leaves are used to drive away chicken lice in the Philippines.--Quisumbing (179).

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HYSSOPUS OFFICINALIS L. Hyssop.

Acetone and water extracts of the whole plant and of the flowers and stems were ineffective against mosquito larvae.--Hartzell (89).

LAMIUM AMPLEXICAULE L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LAVANDULA SPICA L. Spike lavender.

Acetone and water extracts of the flowers were ineffective against mosquito larvae.--Hartzell (89).

Oil of spike lavender did not repel Aedes mosquitoes.--McCulloch and Waterhouse (142).

LAVANDULA VERA DC. True lavender.

Acetone and water extracts of the leaves, stems, and flowers were ineffective against mosquito larvae.--Hartzell (89).

LAVANDULA sp.

Aqueous extracts of the seeds and of the flowers were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LEONOTIS LEONURUS (L.) R. Br.

Aqueous extracts of the branches and leaves and of the roots were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. A petroleum ether extract of the roots was toxic to milkweed bugs and black carpet beetle larvae, but not to German cockroaches, confused flour beetles, and webbing clothes moth larvae. Alcohol and chloroform extracts were toxic to black carpet beetle larvae but not to the other insect species.--Heal and coworkers (93).

LEONOTIS NEPETAEFOLIA (L.) R. Br. Lion's ear, molinillo.

The powdered seeds are effective against lice and insects infesting wounds.--Grosourdy (78).

The powdered ripening seed heads showed considerable toxicity, as a stomach poison, to melonworm larvae and fair toxicity to bean leaf beetle adults, but they were ineffective against diamondback moth larvae. As a contact poison, the powdered seed heads showed much less toxicity to melonworm larvae and fair toxicity to cotton stainer adults, but they were inert to bean beetle adults and Australian cockroach nymphs. The same results were obtained with the powdered leaves except that they were inert to bean leaf beetle adults as a stomach poison. The woody stems and the roots were ineffective against melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Planck (174).

An aqueous extract of the roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

LEONURUS SIBIRICUS L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

LEUCAS ASPERA Link.

LEUCAS ZEYLANICA R. Br.

These plants are used as insecticides in the Philippines.--Quisumbing (179).

LYCOPUS VIRGINICUS L. Betony.

Acetone and water extracts of the leaves were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MARRUBIUM VULGARE L.

An aqueous extract of the whole plant was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MENTHA HAPLOCALYX Briq.

Water suspensions of the leaves, the roots, and the combined leaves and stems were all ineffective against Drosophila hydei larvae.--Yamaguchi and coworkers (233).

MENTHA PIPERITA L. Peppermint.

MENTHA SPICATA L. Spearmint.

Acetone and water extracts of the leaves, stems, and spikes were ineffective against mosquito larvae.--Hartzell (89).

MENTHA PULEGIUM L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MICHELIELLA ANISATA (Sims.) Briq.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MONARDA CITRIODORA Cerv.

An aqueous extract of the tops was nontoxic to German and American cockroaches.--Heal and coworkers (93).

NEPETA CATARIA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

NEPETA NUDA L.

The plant is toxic to flies, mosquito larvae, lice, and bugs (bed-bugs?).--Petrischeva (172).

NEPETA SUBSESSILIS Maxim.

A water suspension of the leaves, stems, and roots was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

NEPETA TEYDEA Webb & Berth.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

OCIMUM BASILICUM L. Sweet basil.

Acetone and water extracts of the leaves and stems were ineffective against mosquito larvae.--Hartzell (89).

The powdered whole plant was nontoxic to melonworms, imported cabbage worms, and codling moths, and extracts had no effect on adult house flies.--Jacobson (108).

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

OCIMUM SANCTUM L. Holy basil.

The plant is used as a mosquito repellent in the Philippines.--Quisumbing (179).

An acetone extract of the stems was ineffective against mosquito larvae.--Jacobson (108).

OCIMUM VIRIDE Willd.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ORIGANUM MAJORANA L.

An aqueous extract of the stems and leaves was slightly toxic to American

cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ORTHODON GROSSESERRATUM Kudo.

A water suspension of the leaves, stems, and flowers was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

PERILLA FRUTESCENS (L.) Britton.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PHYSOSTEGIA PARVIFLORA Nutt.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

PHYSOSTEGIA VIRGINIANA (L.) Benth.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PLATOSTOMA AFRICANUM Beauv.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An aqueous extract of the roots was nontoxic to all these insects.--Heal and coworkers (93).

PLECTRANTHUS FRUTICOSUS L'Her.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

POGOGYNE PARVIFLORA Benth.

An aqueous extract of the branchlets and inflorescence was nontoxic to German and American cockroaches. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

POGOSTEMON CABLIN (Blanco) Benth. Patchouly.

The leaves and tops are used in the Philippines to repel cockroaches, moths, ants, and leeches.--Quisumbing (179).

The plant is reported to have been used in Puerto Rico against clothes vermin. An acetone extract was somewhat toxic to mosquito larvae.--Jacobson (108).

POGOSTEMON HEYNEANUS Benth.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether and chloroform extracts of the leaves were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract of the leaves was nontoxic to all these insects. A petroleum ether extract of the stems and leaves was toxic to black carpet beetle larvae only. Alcohol and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

PYCNANTHEMUM PILOSUM Nutt.

An aqueous extract of the whole plant with flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PYCNOTHYMUS RIGIDUS (Bartr.) Small. Wild savory, pennyroyal.

The powdered plant, especially the leaves, is very effective against the Mexican bean beetle, the European cabbage worm, the looper, and aphids. It is also an activator when used with other insecticides such as nicotine, rotenone, pyrethrum, etc. Extractives prepared with various organic solvents are also effective.--Diem (55).

The powdered plant was neither repellent nor toxic to Mexican bean beetle larvae or bean aphids.--Hansberry and Clausen (86).

The powdered plant was nontoxic to melonworms, southern armyworms, and striped blister beetles.--Bottger and Jacobson (36).

The powdered plant was slightly toxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives showed little or no toxicity to codling moth larvae and house flies.--Jacobson (108).

ROSMARINUS OFFICINALIS L. Rosemary.

The plant is a common insecticide in Venezuela.--Higbee (94).

An acetone extract of the leaves was ineffective against mosquito larvae.--Hartzell (90).

The plant is used as an insecticide in the Philippines.--Quisumbing (179).

Rosemary oil (50 percent in liquid paraffin) was somewhat repellent to the sheep blowfly.--Mackerras and Mackerras (134).

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

SALAZARIA MEXICANA Torr.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SALVIA CARNOSA var. PILOSA (Gray) Jepson.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SALVIA MELLIFERA Greene.

An aqueous extract of the whole plant was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. An aqueous extract of the branches and leaves was slightly toxic to American cockroaches only. Alcohol, petroleum ether, and chloroform extracts of the whole plant were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

SALVIA OFFICINALIS L. Sage.

Acetone and water extracts of the leaves and stems were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SALVIA PLEBEIA R. Br.

A water suspension of the leaves was nontoxic to Drosophila hydei larvae, but suspensions of the combined leaves and stems and of the roots were toxic to these larvae.--Yamaguchi and coworkers (233).

SALVIA REFLEXA Hornem.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SALVIA SCLAREA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SATUREJA CHANDLERI (Brandeg.) Druce.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

SATUREJA DOUGLASII (Benth.) Briq. Synonym: Micromeria chamissonis.

An aqueous extract of the whole plant was very toxic to American cockroaches but not to German cockroaches. A petroleum ether extract was toxic to milkweed bugs and black carpet beetle larvae, but not to German cockroaches, confused flour beetles, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and chloroform extracts were toxic to black carpet beetle larvae only.--Heal and coworkers (93).

SATUREJA HORTENSIS L.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but

German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SATUREJA LAEVIGATA Standl.

The powdered plant was ineffective against Mexican bean beetle larvae.--Hansberry and Clausen (86).

SCUTELLARIA LAETEVIOLACEA Koidz.

An aqueous suspension of the leaves was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

SCUTELLARIA INTEGRIFOLIA L.

SCUTELLARIA PARVULA Michx.

SCUTELLARIA RACEMOSA Pers.

Aqueous extracts of these species were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

STACHYS BULLATA Benth.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

STACHYS PETIOLOSA Briq.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

STACHYS RIEDERI var. HISPIDULA.

A water suspension of the roots was ineffective against Drosophila hydei larvae, but a suspension of the combined leaves and stems was highly toxic to these larvae.--Yamaguchi and coworkers (233).

TETRADENIA FRUTICOSA Benth.

An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TEUCRIUM CANADENSE L. American germander.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

THYMUS VULGARIS L. Thyme.

Acetone and water extracts of the leaves were ineffective against mosquito larvae.--Hartzell (89).

Thymol terpenes did not repel Aedes mosquitoes.--McCulloch and Waterhouse (142).

TRICHOSTEMA LANCEOLATUM Benth.

An aqueous extract of the whole plant was nontoxic to American cockroaches. An extract of the tops and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ZIZIPHORA CLINOPODIOIDES Lam.

The plant was toxic to mosquito larvae, lice, and bugs (bedbugs?).--Petrischeva (172).

LARDIZABALACEAE

AKEBIA QUINATA Decne.

An aqueous extract of the stems and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Petroleum ether and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

DECAISNEA FARGESII Franch.

An aqueous extract of the branches and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LAURACEAE

ANIBA CANELILLA (H. B. K.) Mez.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ANIBA OVALIFOLIA Mez.

The wood is very resistant to termites.--Wolcott (225).

ANIBA PERUTILIS Hemsl.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ANIBA ROSAEODORA Ducke. Brazilian rosewood.

Linalool, obtained from this tree, is an effective termite repellent.--Wolcott (224).

CASSYTHA FILIFORMIS L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

CINNAMOMUM CAMPHORA Nees & Eberm. Camphor tree.

Formosan camphor oil did not repel the Australian sheep blowfly.--Waterhouse (220).

In both knockdown and lethal effects on mosquitoes, safrole among other volatile constituents of camphor oil was found to be most potent and also synergistic with pyrethrins.--Ono (164).

CINNAMOMUM ZEYLANICUM Blume. Cinnamon.

Acetone and water extracts of the bark were ineffective against mosquito larvae.--Hartzell (89).

CRYPTOCARYA AUSTRALIS Benth.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LAURUS NOBILIS L. Laurel.

Acetone and water extracts of the leaves were ineffective against mosquito larvae.--Hartzell (89).

LICARIA CANNELLA (Meissn.) Kosterm.

The wood is very resistant to termites.--Wolcott (225).

LINDERA BENZOIN (L.) Meissn.

An aqueous extract of the branches was slightly toxic to American cockroaches.--Heal and coworkers (93).

MACHILUS THUNBERGII Sieb. & Zucc.

A mixture containing 60 parts powdered dry pyrethrum flowers, 30 parts powdered dry leaf and twig of this plant, and 10 parts wood dust was effective against house flies.--Nagasawa and coworkers (156).

NECTANDRA WHITEI (Woodson) C. K. Allen. Bambito Colorado.

The heartwood of this tree from Panama was moderately resistant to termites.--Scheffer and Duncan (191).

OCOTEA ACUTANGULA (Miq.) Mez.

The wood is resistant to termites.--Wolcott (225).

OCOTEA BULLATA E. Mey.

An aqueous extract of the stem bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

OCOTEA CUJUMARY Mart.

An aqueous extract of the wood was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

OCOTEA CANALICULATA (Rich.) Mez.

OCOTEA LEUCOXYLON (Sw.) Benth. & Hook. Synonym: O. portoricensis. Laurel geo.

OCOTEA MOSCHATA (Meissn.) Mez. Nuez moscada.

OCOTEA RODIEI (Schomb.) Mez. Demerara greenheart.

OCOTEA RUBRA Mez.

OCOTEA WACHENHEIMII Benoist. Silverballs.

Ocotea rodiei is much more resistant to termite attack than the other species.--Wolcott (224).

An aqueous extract of the wood of O. rodiei was nontoxic to German and American cockroaches.--Heal and coworkers (93).

OCOTEA sp.

Species of Ocotea are locally noted in Brazil for their resistance to termite attack.--Wolcott (224).

PERSEA AMERICANA Mill. Synonym: P. gratissima. Avocado.

The wood is very susceptible to termites.--Wolcott (225).

An acetone extract of the fruit was ineffective against mosquito larvae.--Hartzell (90).

Crushed avocado seeds were ineffective against mosquito larvae.--Flock and deLajudie (64).

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PERSEA LINGUE Nees.

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PERSEA PUBESCENS (Pursh) Sarg.

An aqueous extract of the branchlets and eaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ERSEA RIGENS C. K. Allen. Pizarra.

The heartwood of this tree from Panama as moderately resistant to termites.--cheffer and Duncan (191).

HOEBE POROSA (Nees & Mart.) Mez.

An aqueous extract of the wood was nonxic to German and American cockaches.--Heal and coworkers (93).

LEUROTHYRIUM MACRANTHUM Nees.

The wood is susceptible to termites.--lcott (225).

SSAFRAS ALBIDUM (Nutt.) Nees. Synonym: S. variifolium. Sassafras.

An aqueous extract of the branches was ic to German cockroaches and slightly toxic to American cockroaches.--Heal and coworkers (93).

An acetone extract of the root bark was ineffective against mosquito larvae.--Hartzell (90).

The oil is repellent to ants.--Aries (28).

The oil was slightly repellent to Aedes mosquitoes.--McCulloch and Waterhouse (142).

UMBELLULARIA CALIFORNICA (Hook. & Arn.) Nutt.

An aqueous extract of the branches, leaves, roots, and bark of a plant tentatively identified as this species was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LECYTHIDACEAE

BARRINGTONIA ASIATICA (L.) Kurz.

An aqueous extract of the fruits was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An alcohol extract of the fruits was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A petroleum ether extract was nontoxic to all these insects, while a chloroform extract was nontoxic to German cockroaches, milkweed bugs, and Aedes mosquito larvae. Alcohol and petroleum ether extracts of the kernels were toxic to black carpet beetle larvae only, and a chloroform extract of the kernels was ineffective against all these insect species.--Heal and coworkers (93).

BARRINGTONIA RACEMOSA (L.) Blume.

An aqueous extract of the bark was toxic to American cockroaches but not to German cockroaches. Alcohol, petroleum ether, and chloroform extracts were all toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

CAREYA ARBOREA Roxb.

An aqueous extract of the bark was very toxic to American cockroaches when injected into the blood stream. but German

cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract was toxic to larvae of the black carpet beetle and webbing clothes moth, but not to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae. Petroleum ether and chloroform extracts of the bark were nontoxic to all these insects.--Heal and coworkers (93).

CARINIANA PYRIFORMIS Miers. Albarco.

The wood has little resistance to termites.--Wolcott (226).

ESCHWEILERA CORRUGATA (Poit.) Miers.

The wood is susceptible to termites.--Wolcott (225).

ESCHWEILERA GRATA Sandw.

An aqueous extract of the kernels was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ESCHWEILERA ODORA (Poeff.) Miers.

ESCHWEILERA SAGOTIANA Miers.

The wood of E. sagotiana is very resistant to termites.--Wolcott (225).

Aqueous extracts of the kernels and of the shells of both species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GUSTAVIA AUGUSTA L.

Aqueous extracts of the seeds and of the fruits were highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extracts. An alcohol extract of the fruits was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Petroleum ether and chloroform extracts of the fruits were nontoxic to all these insects.--Heal and coworkers (93).

LECYTHIS TUYRANA Pittier.

An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches. An aqueous extract of the roots was nontoxic to both these species and to milkweed bugs.--Heal and coworkers (93).

LEITNERIACEAE

LEITNERIA FLORIDANA Chapm.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LEGUMINOSAE

ABRUS PRECATORIUS L. Crabseye, jequirity, rosary pea.

Acetone and water extracts of the seeds were ineffective against mosquito larvae.--Hartzell (89).

The powdered seeds were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

The powdered seeds, leaves, stems, and roots each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

The combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds had no effect on codling moth larvae and house flies.--Jacobson (108).

ACACIA FARNESIANA (L.) Willd. Casha.

The wood is resistant to termites.--Wolcott (226).

An aqueous extract of the bark and leaves was nontoxic to German and American cockroaches. An aqueous extract of the branches and leaves was very toxic to American cockroaches and nontoxic to German cockroaches. Alcohol, petroleum ether, and chloroform extracts of the branches and leaves were nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

ACACIA LUTEA (Mill.) Britton.

An aqueous extract of the seeds was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ACACIA MACRACANTHA Humb. & Bonpl. Synonym: A. aroma.

An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ACACIA PENNATA Willd.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ADENANTHERA PAVONINA L.

An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

AESCHYNOMENE AMERICANA L.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the fruits was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AESCHYNOMENE SENSITIVA Sw. Swamp grass.

The seeds with pods were appreciably toxic to melonworm larvae, but they were inert to fall armyworm and diamondback moth larvae, Andrector ruficornis, cotton stainer, and rice weevil adults, and American cockroach nymphs.--Plank (174).

Some of the plant parts tested were toxic, as dusts or extracts, to house flies, mosquito larvae, and a number of leaf-eating larvae.--Sievers and coworkers (197).

AESCHYNOMENE VIRGINICA (L.) BSP.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

AFRORMOSIA LAXIFLORA Harms.

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Aqueous extracts of the branches and leaves and of the roots were nontoxic to all these insects. A petroleum ether extract of the branches and leaves was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

ALBIZZIA CHINENSIS (Osbeck) Merr. Synonym: A. stipulata.

The powdered seeds were highly toxic, as a contact poison, to melonworm larvae and cotton stainer adults, but they were inert to Australian cockroach nymphs. As a stomach poison, the seeds showed fair toxicity to melonworm larvae but were ineffective against diamondback moth larvae and bean leaf beetle adults. The petioles were fairly toxic to melonworms but inert to diamondback moths, bean leaf beetles, cotton stainers, and Australian cockroach nymphs. The leaflets showed fair toxicity to melonworms and cotton stainers, but little or no toxicity to diamondback moths, bean leaf beetles, and Australian cockroach nymphs. The bark, wood, and roots each showed little or no toxicity to all these insects.--Plank (174).

ALBIZZIA LEBBECK (L.) Benth. Yellow acacia.

The powdered seeds were fairly toxic to melonworm larvae and cotton stainer adults, but they were inert to bean leaf beetle adults and Australian cockroach nymphs. Leaflets and petioles were fairly toxic to cotton stainer adults but not to melonworms, bean leaf beetles, and Australian cockroach nymphs. The bark and roots were toxic to melonworm larvae only. The pods were toxic only to cotton stainer adults. The wood was inert to all these insects.--Plank (174).

An aqueous extract of the seeds and bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ALEXA sp.

An aqueous extract of the bark was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. A chloroform extract

was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and petroleum ether extracts were nontoxic to all these insects.--Heal and coworkers (93).

AMBURANA CEARENSIS (Fr. Allem.) A. C. Sm.

An aqueous extract of the wood was nontoxic to German and American cockroaches. An alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

AMORPHA CANESCENS Pursh.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

AMORPHA FRUTICOSA L. False indigo.

Both the roots and the fruit of this plant contain insecticidal material, but it occurs to a much greater extent in the fruit. A 10-percent emulsion of the acetone extract of the fruits gave very promising results against cattle grubs.--Featherly and Harmon (61).

A glycoside, amorpha, obtained from the plant, was effective as a dust against chinch bugs, cotton aphids, bean leaf beetles, spotted cucumber beetles, potato leafhoppers, tarnished plant bugs, squash bugs, and blister beetles. It was ineffective against cabbage loopers, grasshoppers, chrysanthemum aphids, mealy bugs, red spiders, chicken mites, and dog fleas. Extracts of amorpha in water were more toxic than 1-percent rotenone to mosquito larvae.--Brett (38).

An acetone extract of the flowers showed little repellent effect against mosquitoes, but it was repellent to chinch bugs and striped cucumber beetles.--Brett (39).

By chlorinating an extract of the fruits, a viscous, slowly-volatile substance was obtained, the concentrated fumes of which were extremely toxic to adult house flies and mosquitoes. The untreated extract is an insect repellent but its toxicity is relatively low.--Brett and Hodnett (40).

The powdered mature pods with seeds were moderately toxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

A solid material obtained from the petroleum ether extract of the seeds was toxic to house flies and codling moth larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the leaves, twigs, and stems were nontoxic to house flies and only slightly toxic to codling moth larvae.--Jacobson (108).

Although extractives prepared from several samples of seeds gave positive color tests for rotenone, no rotenone or rotenoids could be isolated. The chloroform extractive yielded a crystalline glycoside, amorphin, melting at 151°, which gave positive color tests for rotenone, as did a crystalline aglycone, amorphigenin, melting at 192°.--Acree and coworkers (2,3).

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An extract of the fruits was toxic to American cockroaches only.--Heal and coworkers (93).

AMORPHA GLABRA Desf.

An aqueous extract of the roots was toxic to American cockroaches and milkweed bugs, but not to German cockroaches. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

AMPHICARPA BRACTEATA var. COMOSA (L.) Fern. Synonym: A. comosa.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

ANDIRA ANTHELMINTICA Benth.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ANDIRA INERMIS (Wright) H. B. K. Synonym: A. jamaicensis. Mocha, angelin.

The wood is resistant to termites.--Wolcott (225).

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ANDIRA SURINAMENSIS (Bondt) Splitz. Demerara bat seed.

The plant is resistant to termite attack. --Wolcott (224).

ANTHYLLIS VULNERARIA L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

ANTHOCLEISTA FREZOULSII A. Chev.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

APIOS AMERICANA Medic.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

APIOS FORTUNEI Maxim.

A water suspension of the leaves, stems, and roots was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

APURIMACIA INCARUM Harms.

Aqueous extracts of the roots and leaves and of the stems and leaves were nontoxic to German and American cockroaches and milkweed bugs. An extract of a sample of the roots was toxic to milkweed bugs only, but an extract of a second sample of roots was toxic to American cockroaches and milkweed bugs. A petroleum ether extract of the stems and leaves was toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae. An alcohol extract was toxic only to black carpet beetle larvae, and a chloroform extract was nontoxic to all these insects. The same results were obtained with petroleum ether, alcohol, and chloroform extracts of the roots and leaves. Petroleum ether extracts of the roots and of the bark were toxic to milkweed bugs and larvae of the webbing clothes moth and black carpet beetle, but nontoxic to German cockroaches and Anopheles mosquito larvae. Alcohol and chloroform extracts of the roots and of the bark were toxic to black carpet beetle larvae only.--Heal and coworkers (93).

APURIMACIA MICHELII (Rusby) Harms.

An acetone extract of the roots was toxic to mosquito larvae.-- Jacobson (108).

ARACHIS HYPOGAEA L. Peanut, groundnut.

Crude peanut oil was equal to or superior to petroleum oil against oystershell scale, Mexican mealybug, and willow scurfy scale. Refined peanut oil was less effective.--Cressman and Dawsey (51).

Peanut oil was effective against San José scale.--Viel (216).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ASTRAGALUS BISULCATUS A. Gray. Two-grooved milk vetch.

An acetone extract of the aerial portion was ineffective against mosquito larvae.--Jacobson (108).

ASTRAGALUS BLAKEI Eggleston.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

ASTRAGALUS CALYCOSUS Torr.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ASTRAGALUS CONVALLARIUS Greene. Synonym: A. campestris. Timber milk vetch, poison vetch.

An acetone extract of the aerial portion was ineffective against mosquito larvae.--Jacobson (108).

ASTRAGALUS CANADENSIS L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

ASTRAGALUS DIPHYSUS A. Gray.

An aqueous extract of the upper parts was slightly toxic to American cockroaches. --Heal and coworkers (93).

ASTRAGALUS DRUMMONDII Dougl.

An aqueous extract of the fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ASTRAGALUS GARBANCILLO Cav. Synonym: A. unifultus.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the stems and flowers was nontoxic to all these insects.--Heal and coworkers (93).

ASTRAGALUS GUMMIFER Labill. Tragacanth.

Acetone and water extracts of gum tragacanth were ineffective against mosquito larvae.--Hartzell (89).

ASTRAGALUS NEGLECTUS (T & G) Sheld.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

ATELEIA GUMMIFERA (Bertol.) D. Dietr.

An aqueous extract of the gum was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BAILLERIA ASPERA.

The crushed leaves and stalks were ineffective against mosquito larvae.--Flock and deLajudie (64).

BAILLERIA BARBASCO. Barbasco sigui.

The powdered stems and roots were both nontoxic to southern beet webworms, melonworms, cross-striped cabbage worms, and southern armyworms.--Bottger and Jacobson (36).

Combined petroleum ether and ethyl ether extractives and combined chloroform and alcohol extractives of the stems and of the roots were all nontoxic to house flies and codling moth larvae. Petroleum ether, combined ethyl ether and chloroform, and alcohol extractives of the leaves were all nontoxic to house flies and codling moth larvae.--Jacobson (108).

BAPHIA POLYGALACEA Baker.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BAPTISIA LEUCANTHA T. & G.

An aqueous extract of the stems, leaves, and fruits was nontoxic to German and American cockroaches.--Heal and coworkers (93).

BAPTISIA TINCTORIA (L.) R. Br. Wild indigo.

Acetone and water extracts of the roots were ineffective against mosquito larvae.--Hartzell (89).

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

BAUHINIA sp.

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

BENTHAMANTHA CARIBAEA (Jacq.) Kuntze.

Some of the plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

BOWDICHIA BRAZILIENSIS Ducke. Sapupira.

The wood is resistant to termites.--Wolcott (225).

BOWDICHIA VIRGILIOIDES H. B. K. Synonym: B. major.

Aqueous extracts of the bark and of the seeds were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

BRACHYSTEGIA SPICIFORMIS Benth.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BRONGNIARTIS sp.

BROWNEA sp.

Aqueous extracts of the branches and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BRYA EBENUS DC.

An aqueous extract of the wood was nontoxic to German and American cockroaches. --Heal and coworkers (93).

BURKEA AFRICANA Hook.

Aqueous extracts of the bark and stems and of the branches and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BUTEA FRONDOSA Roxb. Palas.

Petroleum ether and alcohol extracts of the seeds, tested at a concentration of 1 percent in water, were effective against mosquito larvae.--Pendse and coworkers (168).

A cold water extract of 10 grams of seeds in 100 milliliters of water gave complete kill of mosquito larvae in 17 hours.--Pendse and coworkers (167).

An aqueous extract of the roots and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BUTEA SUPERBA Roxb.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CAESALPINIA BAHAMENSIS Lam.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CAESALPINIA CORIARIA (Jacq.) Willd. Synonym: Libidibia coriaria.

An aqueous extract of a sample of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs, while aqueous extracts of the fruits and of the branches and leaves of another sample of plant were toxic to American and German cockroaches and nontoxic to milkweed bugs. Alcohol and chloroform extracts of the second sample of branches and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. A petroleum ether extract was toxic to milkweed bugs and black carpet beetle larvae only. Alcohol, petroleum ether, and chloroform extracts of the fruits were toxic to black carpet beetle larvae only.--Heal and coworkers (93).

CAESALPINIA GILLIESII (Hook) Wall. Synonym: Erythrostemon gilliesii.

An aqueous extract of the flowers was nontoxic to American cockroaches. A chloroform extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and petroleum ether extracts were nontoxic to all these insects.--Heal and coworkers (93).

CAESALPINIA PULCHERRIMA (L.) Sw. Synonym: Poinciana pulcherrima.

The powdered plant was ineffective against Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches. An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CAESALPINIA SPINOSA (Molina) Kuntze. Synonym: C. tinctoria.

An aqueous extract of the wood was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. A petroleum ether extract of the bark was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour

beetles, and larvae of the webbing clothes moth and Aedes mosquito. Alcohol and chloroform extracts of the bark were nontoxic to all these insects.--Heal and coworkers (93).

CAJANUS CAJAN (L.) Druce. Synonym: C. indicus.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CALLIANDRA ANOMALA (Kunth) Macbr.

An aqueous extract of the stems was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CALLIANDRA MARGINATA Griseb.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CALOPOGONIUM COERULEUM (Benth.) Sauv.

The powdered pods and the seeds were fairly toxic to melonworm, fall armyworm, and diamondback moth larvae, but they were inert to Andrector ruficornis and cotton stainer adults and Australian cockroach nymphs.--Plank (174).

CALOPOGONIUM MUCUNOIDES Desv.

Some plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CAMPSIANDRA COMOSA Benth.

An aqueous extract of the stem bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CANAVALIA ENSIFORMIS (L.) DC. Jackbean, pallar chuncho.

Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds were nontoxic to house flies.--Jacobson (108).

An aqueous extract of the seeds was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the seeds were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and webbing clothes moth larvae. The alcohol extract was also ineffective against Aedes mosquito larvae.--Heal and coworkers (93).

CANAVALIA MACROPLEURA Piper.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CANAVALIA MARITIMA (Aubl.) Thou. Synonym: C. lineata.

An aqueous extract of a sample of the seeds was nontoxic to German and American cockroaches. An extract of a second sample of seeds was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae, but a suspension of the seeds was only slightly toxic to these larvae.--Yamaguchi and coworkers (233).

CARAGANA ARBORESCENS Lam.

The powdered plant was nontoxic to Ixodes and Dermacentor ticks, bedbugs, house flies, Aedes and Anopheles mosquitoes, and Drosophila.--Olenev (163).

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CASSIA ACUTIFOLIA Delile. Senna.

Acetone and water extracts of the pods were ineffective against mosquito larvae.--Hartzell (89).

CASSIA ALATA L. Ringworm cassia, barbasco macagua.

Leaf extracts were highly toxic to mosquito larvae.--Sievers and coworkers (197).

The powdered leaflets, petioles, bark, and wood were ineffective against melonworm and diamondback moth larvae, Andrector ruficornis and cotton stainer adults, and

Australian cockroach nymphs. The powdered immature and ripe fruits were moderately toxic to melonworm larvae, but they were inert toward diamondback moth larvae, *A. ruficornis* and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

Aqueous extracts of the leaves, the branchlets, the fruits, and the stem bark were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds were nontoxic to house flies.--Jacobson (108).

CASSIA ANGUSTIFOLIA Vahl. Senna.

Acetone and water extracts of the pods and of the leaves were ineffective against mosquito larvae.--Hartzell (89).

CASSIA ARMATA S. Wats.

CASSIA DIDYMOBOTRYA Fresen.

Aqueous extracts of the roots of these species were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the branches and leaves of the latter species gave the same results.--Heal and coworkers (93).

CASSIA EMARGINATA L.

The powdered pods were nontoxic to nelonworms, southern armyworms and cross-striped cabbageworms.--Bottger and Jacobson (36).

Combined petroleum ether and ethyl ether extractives and combined chloroform and alcohol extractives of the pods were nonoxic to codling moth larvae. Combined chloroform and alcohol extractives were oxic to German cockroach nymphs but not o adult male and female German cockroaches.--Jacobson (108).

ASSIA FASCICULATA Michx.

An aqueous extract of the whole plant as nontoxic to German and American cockoaches and milkweed bugs.--Heal and coorkers (93).

ASSIA FISTULA L.

An aqueous extract of the fruits was oxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the seeds and pods was toxic to American but not to German cockroaches.--Heal and coworkers (93).

CASSIA HEBECARPA Fern.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

CASSIA HIRSUTA L.

Some plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CASSIA LEPTOCARPA Benth.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CASSIA NICTITANS L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

CASSIA NODOSA Buch-Ham.

The powdered seeds, leaves, petioles, and bark showed little or no toxicity to several species of insects.--Plank (173).

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

The powdered leaflets and petioles were ineffective against melonworm, fall armyworm, and diamondback moth larvae and *Andrector ruficornis* adults. The powdered seeds were inert to melonworm, fall armyworm, and *Brenthia pavonacella* larvae, and the powdered bark was ineffective against these larvae and *A. ruficornis* adults. The powdered roots were moderately toxic to melonworm and fall armyworm larvae, but they were ineffective against *A. ruficornis* and cotton stainer adults and Australian cockroach nymphs.--Plank (174).

CASSIA OCCIDENTALIS L.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CASSIA QUINQUANGULATA L. C. Rich.
Synonym: C. antillana.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CASSIA SIAMEA Liam. Kassod-tree.

The wood is very susceptible to termites.--Wolcott (225).

CASSIA SIEBERIANA DC.

An aqueous extract of the ripe fruit was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CASSIA SOPHORA L.

An aqueous extract of the seeds was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CASSIA SPECTABILIS DC.

Leaf extracts were highly toxic to mosquito larvae.--Sievers and coworkers (197).

The powdered leaves were moderately toxic to melonworm larvae, but they were inert to fall armyworm larvae, Andrector ruficornis and cotton stainer adults, and Australian cockroach nymphs. The powdered petioles, bark, and wood were inert to all these insects.--Plank (174).

CASSIA TOMENTOSA L.

An aqueous extract of the roots, leaves, and branches was nontoxic to German and American cockroaches and milkweed bugs. --Heal and coworkers (93).

CASSIA TORA L. Coffee weed, sickle senna.

The powdered seeds were toxic to Autographa 00 but not to melonworms, southern armyworms, and striped blister beetles.--Bottger and Jacobson (36).

The powdered seeds were nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds were nontoxic to house flies and codling moth larvae. --Jacobson (108).

An aqueous extract of the upper parts was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CENTROSEMA PLUMIERI (Turp.) Benth.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CENTROSEMA PUBESCENS Benth.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CENTROSEMA VIRGINIANA (L.) Benth.

An aqueous extract of the whole plant was toxic to milkweed bugs but not to German and American cockroaches.--Heal and coworkers (93).

CERATONIA SILIQUA L.

An aqueous extract of the fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CERCIDIUM MICROPHYLLUM (Torr.) Rose & Johnst.

An aqueous extract of the branchlets, leaves, and fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CERCIS CANADENSIS L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

CERCIS CHINENSIS Bunge.

An aqueous extract of the branches and leaves was toxic to milkweed bugs but not to German and American cockroaches. An extract of the fruits was nontoxic to all these insects.--Heal and coworkers (93).

CLADRASTIS LUTEA (Michx. f.) Koch.

An aqueous extract of the branches, leaves, and fruits, was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CLATHOTROPIS MACROCARPA Ducke.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CLITORIA ARBOREA Benth.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CLITORIA ARBORESCENS Ait.

Aqueous extracts of the branchlets, the leaves, and the roots were all toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. A petroleum ether extract of the roots and seeds was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and chloroform extracts were nontoxic to these insects.--Heal and coworkers (93).

CLITORIA MARIANA L.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CLITORIA RUBIGINOSA Juss.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CLITORIA TERNATA L.

Aqueous extracts of the whole plant and the seeds were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CLITORIA sp.

An aqueous extract of the roots was highly toxic to American cockroaches and nontoxic to German cockroaches. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

COLOGANIA PALLIDA Rose.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

COLUTEA ARBORESCENS L.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COPAIFERA LANGSDORFII Desf.

Caryophyllene, present in the wood, offers little protection against termite attack at low concentrations, but 5 percent caryophyllene prevented termites from eating treated wood for almost 4 weeks.--Wolcott (224).

An aqueous extract of the stems and bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CORONILLA VARIA L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CORYNELLA PAUCIFOLIA DC.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the branchlets and fruits was nontoxic to all these insects.--Heal and coworkers (93).

COURSETIA AXILLARIS Coult. & Rose.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CROTALARIA AGATIFLORA Schweinf. f.

An aqueous extract of the seeds was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

CROTALARIA ANGULATA Mill. Synonym: C. rotundifolia. Rabbit-bells.

An acetone extract of the roots was ineffective against mosquito larvae.--Jacobson (108).

CROTALARIA CALYCINA Schrank. Synonym: C. stricta.

Aqueous extracts of the whole plant and of the seeds were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CROTALARIA INCANA L.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CROTALARIA SAGITTALIS L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the whole plant was somewhat toxic to American cockroaches but not to German cockroaches and milkweed bugs. Alcohol and petroleum ether extracts of the whole plant and of the fruits were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

CROTALARIA SPECTABILIS Roth. Showy crotalaria.

The combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds and of the aerial portions both showed some toxicity to house flies. Monocrotaline, isolated from the alcohol extract of the seeds, was nontoxic to southern armyworms, peach aphids, and European corn borer larvae.--Jacobson (108).

CYTISUS SCOPARIUS (L.) Link. Scotch broom.

An acetone extract of the tops was ineffective against mosquito larvae.--Hartzell (90).

An aqueous extract of the branchlets and leaves was nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

DALBERGIA CUMINGIANA Benth.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

DALBERGIA NIGRA Allem.

DALBERGIA RETUSA Baill.

Aqueous extracts of the wood of these species were nontoxic to German and American cockroaches.--Heal and coworkers (93).

DALEA ARGYRAEA (A.) Gray.

The powdered plant was nontoxic to melonworms, southern armyworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies and codling moth larvae.--Jacobson (108).

DALEA CARTHAGINENSIS (Jacq.) Macbr. Synonym: D. domingensis.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating insects.--Sievers and coworkers (197).

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93)

DALEA CITRIODORA Willd.

The powdered leaves and stems were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

DALEA KINGII S. Wats.

An aqueous extract of the upper parts was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DALEA MOLLIS var. MOLLISSIMA (Rydb.) Munz.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

DALEA SPINOSA A. Gray.

An aqueous extract of the roots and stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DALEA TINCTORIA Brand.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DAUBENTONIA PUNICEA (Cav.) DC.

DAUBENTONIA TEXANA Pierce. Synonym: D. drummondii. Rattle-bush, rattle-box.

The powdered seeds were nontoxic to melonworms and striped blister beetles.--Bottger and Jacobson (36).

The powdered seeds were nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds were nontoxic to house flies and codling moth larvae.--Jacobson (108).

An aqueous extract of the seeds was nontoxic to German and American cockroaches.--Heal and coworkers (93).

DELONIX REGIA (Boj.) Raf. Royal poinciana, flame-tree, peacock flower.

The wood is very susceptible to termites.--Wolcott (225).

An aqueous extract of the seeds was toxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DERRIS ELLIPTICA (Wall.) Benth.

The roots are used as an insecticide in the Philippines.--Quisumbing (179).

An acetone extract of the roots was toxic to Culex pipiens larvae. The toxicity was traced to the water-insoluble portion of the extract.--Yamaguchi and coworkers (232).

A 10-percent Pyrax dust of the roots was toxic to melonworms and pickleworms, but not to southern armyworms and striped blister beetles.--Bottger and Jacobson (36).

DERRIS FORDII Oliv.

Acetone extracts of the roots were toxic by contact to bean aphids and saw-toothed grain beetles. The powdered root was highly toxic to diamondback moth larvae.--Tattersfield and coworkers (209).

The powdered root was toxic to bean aphids.--Chiu and coworkers (48).

A water suspension of the roots was very effective against the bean plataspid.--Chiu (47).

DERRIS TRIFOLIATA Lour.

The roots are used as an insecticide in the Philippines.--Quisumbing (179).

DESMODIUM CAUDATUM DC.

An acetone extract of the leaves was toxic to Culex pipiens larvae. The toxicity was traced to the water-insoluble portion of the extract.--Yamaguchi and coworkers (232).

DESMODIUM CANADENSE (L.) DC.

DESMODIUM GLUTINOSUM (Muhl.) Wood.

DESMODIUM PANICULATUM DC.

DESMODIUM PERPLEXUM Schubert. Synonym: D. dillenii.

The powdered plants were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

DESMODIUM LABURNIFOLIUM DC.

An aqueous extract of the branchlets and leaves was toxic to American cock-

roaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the fruits was very toxic to American cockroaches, and nontoxic to the other insects tested.--Heal and coworkers (93).

DESMODIUM UNCINATUM (Jacq.) DC.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DICHROSTACHYS GLOMERATA (Forsk.) Chiov. Synonym: D. nutans.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DIOCLEA MACRANTHA Huber.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

DIOCLEA REFLEXA Hook.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DIOCLEA SERICEA H. B. K.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

DIPLOTROPIS PURPUREA (Rich.) Amsh.

The wood is resistant to termites.--Wolcott (225).

DOLICHOS BUCHANANI Harms.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether and chloroform extracts of the roots were toxic to milkweed bugs, confused flour beetles, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito, and nontoxic to German cockroaches. An alcohol extract was toxic only to confused flour beetles and larvae of the black carpet beetle and Aedes mosquito.--Heal and coworkers (93).

DOLICHOS KILIMANDSCHARICUS Taub.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DOLICHOS LABLAB L.

Aqueous extracts of the roots and of the seeds were nontoxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts of the seeds and of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ENTADA GIGAS (L.) Fawc. & Rendle.

An aqueous extract of the seeds was slightly toxic to American cockroaches and milkweed bugs. An alcohol extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Petroleum ether and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

ENTADA PHASEOLOIDES (L.) Merr.

An aqueous extract of the seeds was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ENTADA POLYSTACHYA (L.) DC.

The powdered leaflets, petioles, and stems showed little or no toxicity to several species of insects.--Plank (173).

An infusion of the plant is used in El Salvador as a contact poison on cotton leafworms.--Wellman and van Severen (221).

The powdered leaflets, petioles, and stems each showed little or no toxicity to melonworms, fall armyworms, and diamondback moth larvae. The powdered roots showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults and Australian cockroach nymphs.--Plank (174).

ENTEROLOBIUM CONTORTISILIQUUM (Vell.) Norong.

Aqueous extracts of the fruits and of the stems were very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol and chloroform extracts of the fruits were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Alcohol, petroleum ether, and chloroform extracts of the stems were toxic to black carpet beetle larvae only.--Heal and coworkers (93).

ENTEROLOBIUM CYCLOCARPUM Griseb. Guanacaste, conacaste.

The powdered leaflets, petioles, bark, and wood showed little or no toxicity to several species of insects.--Plank (173).

An infusion of the ground fruits is used in El Salvador as a contact poison on the cotton leafworm and the cotton boll weevil.--Wellman and van Severen (221).

The wood is resistant to termites.--Wolcott (226).

The powdered bark was toxic to southern oeet webworms but not to melonworms and southern armyworms.--Bottger and Jacobson (36).

The powdered bark was nontoxic to Euroean corn borer larvae. Combined petroleum ther, ethyl ether, chloroform and alcohol xtractives were nontoxic to house flies nd codling moth larvae.--Jacobson (108).

The powdered leaflets, petioles, bark, nd wood each showed little or no toxicity melonworm, fall armyworm, and iamondback moth larvae.--Plank (174).

An aqueous extract of the bark was toxic American cockroaches but not to German ockroaches. An alcohol extract of the eeds was toxic to black carpet beetle rvae, but not to German cockroaches, ilkweed bugs, and larvae of the webbing othes moth and Aedes and Anopheles osquitoes. Petroleum ether and chlororm extracts of the seeds were nontoxic all these insects. Alcohol and petroleum her extracts of the roots were toxic black carpet beetle larvae, but not to rman cockroaches, milkweed bugs (expt the petroleum ether extract which s toxic), and larvae of the webbing othes moth and Aedes and Anopheles osquitoes. A chloroform extract of the roots was nontoxic to all these insects.--Heal and coworkers (93).

EPERUA FALCATA Aubl.

The wood is susceptible to termites.--Wolcott (225).

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ERYTHRINA AMERICANA Mill.

An aqueous extract of the seeds was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ERYTHRINA BERTEROANA Urban.

An aqueous extract of the seeds was very toxic to American cockroaches when injected into the blood stream, but German cockroaches ware unaffected after immersion in the extract.--Heal and coworkers (93).

ERYTHRINA GLAUCA Willd.

The plant is used as an insecticide in British Guiana.--Fanshawe (60).

An aqueous extract of the seeds was toxic to American cockroaches.--Heal and coworkers (93).

ERYTHRINA POEPPIGIANA (Walp.) O. F. Cook.

An aqueous extract of the seeds was slightly toxic to American cockroaches.--Heal and coworkers (93).

ERYTHRINA RUBRINERVIA H. B. K.

The powdered seeds were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

ERYTHRINA VARIEGATA ORIENTALIS (L.) Merr.

The powdered roots and seeds with pods showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

ERYTHRINA sp.

The powdered leaves, petioles, bark, and wood each showed little or no toxicity to

melonworm and diamondback moth larvae, Diabrotica bivitatta, and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

ERYTHROPHLEUM COUMINGA Baill.

An aqueous extract of the bark chips was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae (the chloroform extract was also toxic to Anopheles mosquito larvae), but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ERYTHROPHLEUM GUINEENSE G. Don.

An aqueous extract of the bark was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An extract of the roots was slightly toxic to American cockroaches only. Alcohol, petroleum ether, and chloroform extracts of the wood were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ERYTHROPHLEUM IVORENSE A. Chev.

Alcohol, petroleum ether, and chloroform extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes mosquito. Petroleum ether and chloroform extracts of the bark were toxic to black carpet beetle larvae only, while an alcohol extract of the bark was nontoxic to all these insects.--Heal and coworkers (93).

EYSENHARDTIA ADENOSTYLIS Baill.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches. An extract of the wood was nontoxic to both species.--Heal and coworkers (93).

EYSENHARDTIA ORTHOCARPA (A. Gray) S. Wats.

An aqueous extract of the wood was toxic to American cockroaches when injected into the blood stream, but milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

EYSENHARDTIA POLYSTACHYA (Ortega) Sarg.

An aqueous extract of the wood was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EYSENHARDTIA TEXANA Scheele.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the branches, leaves, and roots was slightly toxic to American cockroaches only. Alcohol, petroleum ether, and chloroform extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

FLEMINGIA STROBILIFERA Ait.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GALACTIA VIRIDIFLORA (Rose) Standl.

Aqueous extracts of the branchlets, leaves, and fruits, of the whole plant, and of the tops, leaves, and fruits were all nontoxic to German and American cockroaches.--Heal and coworkers (93).

GALACTIA VOLUBILIS (L.) Britton. Downy milkpea.

An acetone extract of the roots was ineffective against mosquito larvae.--Jacobson (108).

GALACTIA WRIGHTII A. Gray.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GALACTIA sp. Milkpea.

An acetone extract of the roots was ineffective against mosquito larvae.--Jacobson (108).

GALEGA OFFICINALIS L. Galega.

Acetone and water extracts of the whole plant were ineffective against mosquito larvae.--Hartzell (89).

GEOFFREA SUPERBA Humb. & Bonpl.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream. Aqueous extracts of the branches and leaves and of the roots were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GLEDITSIA AMORPHOIDES (Griseb.) Taub.

An aqueous extract of the fruit was highly toxic to German and American cockroaches and nontoxic to milkweed bugs. Alcohol and chloroform extracts of the fruits were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

GLEDITSIA AQUATICA Marsh.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was nontoxic to all these insects. A petroleum ether extract of the fruits was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and webbing clothes moth and Anopheles mosquito larvae. Alcohol and chloroform extracts of the fruits and of the roots were nontoxic to all these insects.--Heal and coworkers (93).

GLEDITSIA FERA (Lour.) Merr.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches, but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GLEDITSIA SINENSIS Lam. Synonym: G. horrida.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

GLEDITSIA TRIACANTHOS L.

The powdered leaves and stems, seeds, and pods were all nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

GLIRICIDIA SEPIUM (Jacq.) Steud.

The powdered leaves, petioles, and bark showed little or no toxicity to several species of insects.--Plank (173).

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An infusion of the bark is used in El Salvador against coccids and aphids.--Wellman and van Severen (221).

The powdered green fruit, ripe fruit, leaves, and stems were all toxic to southern armyworms. The powdered green fruit was nontoxic to cabbage loopers and Noropsis hieroglyphia, but somewhat toxic to imported cabbageworms. The ripe fruit was nontoxic to cabbage loopers. The powdered leaves were nontoxic to melonworms, Hawaiian beet webworms, and southern beet webworms, but they were toxic to yellow woolybears. The powdered roots were nontoxic to melonworms, Hawaiian beet webworms, and southern beet webworms, but they were toxic to cabbage loopers and yellow woolybears. The flower clusters were toxic to southern armyworms but not to cabbage loopers. A petroleum ether extract of the ripe fruit was nontoxic to house flies. Acetone and alcohol extracts of all plant parts were nontoxic to mosquito larvae, but petroleum ether extracts of the flower clusters, leaves, ripe fruit, and roots were all toxic to these larvae. A petroleum ether extract of the stems was slightly toxic to mosquito larvae.--Sievers and coworkers (197).

Powdered green or ripe fruits showed little or no toxicity to melonworms, fall armyworms, and diamondback moth larvae, bean leaf beetle, rice weevil, and cotton stainer adults, and American cockroach nymphs. The same results were obtained with the powdered leaves and petioles against Brenthia pavonacella, melonworm, Hawaiian beet webworm, and fall armyworm larvae. The powdered bark gave the same results with Brenthia pavonacella, melonworm, fall armyworm, southern beet web-

worm, and diamondback moth larvae.--Plank (174).

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches. An aqueous extract of the bark and wood was slightly toxic to American cockroaches but not to German cockroaches. Aqueous extracts of the branchlets and leaves and of the roots were nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

GLOTTIDIUM VESICARIUM (Jacq.) Harper. Bladder-pod.

The powdered seeds were nontoxic to Autographa 00, cabbage loopers, cross-striped cabbageworms, melonworms, and southern armyworms.--Bottger and Jacobson (36).

The powdered seeds showed slight toxicity to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds were nontoxic to house flies and codling moth larvae.--Jacobson (108).

An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

GLYCINE SOJA (L.) Merr. Synonym: Soja max. Soybean.

Satisfactory spray mixtures for control of codling moths could be prepared when crude raw soybean oil was added to nicotine bentonite or lead arsenate.--Steiner and coworkers (200).

Soybean oil soap was toxic to the sugarcane wooly aphis.--Cheu (45).

GLYCYRRHIZA GLABRA L. Licorice.

Acetone and water extracts of the roots were ineffective against mosquito larvae.--Hartzell (89).

GLYCYRRHIZA LEPIDOTA (Nutt.) Pursh.

An aqueous extract of the roots and fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GOURLIEA SPINOSA (Mol.) Skeels.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the stem bark was slightly toxic to American cockroaches only.--Heal and coworkers (93).

GYMNOCLADUS DIOICA (L.) Koch. Kentucky coffee tree.

The powdered seeds and pods were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the leaves was nontoxic to house flies and codling moth larvae.--Jacobson (108).

Aqueous extracts of the leaves, of the branches and leaves, of the fruits, and of the stems were all toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. An aqueous extract of the seeds was nontoxic to all these insects. A petroleum ether extract of the stems and leaves was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts of the stems and leaves were nontoxic to all these insects and to Aedes mosquito larvae. Alcohol and petroleum ether extracts of the branches and leaves were toxic to black carpet beetle larvae only, and a chloroform extract was nontoxic to all these insects. Alcohol, chloroform, and petroleum ether extracts of the stems were toxic to black carpet beetle larvae and nontoxic to the other insects tested as well as to confused flour beetles.--Heal and coworkers (93).

HAEMATOXYLON BRASILLETO Karst.

The powdered leaves and stems were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

HAEMATOXYLON CAMPECHIANUM L. Logwood.

Acetone and water extracts of logwood chips were ineffective against mosquito larvae.--Hartzell (89).

Submerging a termite-susceptible wood for 10 minutes in a 2-percent solution of hematoxylon, a dye obtained from the heartwood of this tree, will protect it from termite attack for nearly 3 weeks.--Wolcott (224).

An aqueous extract of the branches, leaves, and seeds was toxic to American cockroaches when injected into the blood

stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HARDWICKIA MANNII Oliver. Synonym: Copaifera manii.

Caryophyllene, present in the wood, offers little protection against termite attack at low concentrations, but 5-percent caryophyllene did prevent termites from eating treated wood for almost 4 weeks.--Wolcott (225).

HEDYSARUM ALPINUM var. AMERICANUM Michx.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HEDYSARUM BOREALE Nutt.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

HEDYSARUM BOREALE var. UTAHENSE (Rydb.) Rollins.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HOFFMANNSEGGIA DENSIFLORA Benth.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HYMENAEA COURBARIL L. West Indian locust tree.

The wood is very resistant to termites.--Wolcott (225).

INDIGOFERA CAROLINIANA Mill.

An acetone extract of the plant was ineffective against mosquito larvae.--Jacobson (108).

Aqueous extracts of the branchlets, leaves, and fruits, and of the roots were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

INDIGOFERA ENDECAPHYLIA Jacq.

The powdered seeds, leaves, and stems showed little or no toxicity to several species of insects.--Plank (173).

The powdered seeds, leaves, and stems each showed little or no toxicity to Brenthia pavonacella, melonworm, and fall armyworm larvae.--Plank (174).

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

INDIGOFERA SUFFRUTICOSA Mill. Synonyms: I. anil, I. lindheimeriana.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

Some plant parts, as dusts or extracts, were toxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

The powdered seeds and stems were both nontoxic to melonworm and southern armyworm larvae.--Bottger and Jacobson (36).

Both the powdered seeds and the powdered stems were nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds and of the stems were nontoxic to house flies and codling moth larvae.--Jacobson (108).

Aqueous extracts of the roots, leaves, and fruits, and of the roots alone were nontoxic to German and American cockroaches. An aqueous extract of the seeds was toxic to American cockroaches only.--Heal and coworkers (93).

INDIGOFERA TINCTORIA L.

A tincture of the seeds is used to destroy lice in the Philippines.--Quisumbing (179).

INGA VERA Willd.

The wood is very susceptible to termites.--Wolcott (225).

KENNEDYA PROCURRENS Benth.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LABURNUM ANAGYROIDES Medic.

An aqueous extract of the branchlets and leaves was nontoxic to German and

American cockroaches and milkweed bugs.--Heal and coworkers (93).

LABURNUM sp.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LATHYRUS LATIFOLIUS L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LATHYRUS JAPONICUS Willd. Synonym: L. maritimus.

LATHYRUS OCHROLEUCUS Hook.

LATHYRUS PALUSTRIS L.

The powdered plants were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

LATHYRUS SYLVESTRIS L.

An aqueous extract of the stems and leaves was toxic to German cockroaches and slightly toxic to American cockroaches.--Heal and coworkers (93).

LATUS CORNICULATUS L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

LEPTODERRIS FASCICULATA Dunn.

An aqueous extract of the stem bark was toxic to milkweed bugs but not to German and American cockroaches.--Heal and coworkers (93).

LESPEDEZA BICOLOR Turcz.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LESPEDEZA CAPITATA Michx.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LESPEDEZA HIRTA (L.) Hornem.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

LESPEDEZA INTERMEDIA (S. Wats.) Britton.

The powered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the tops, leaves, and fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LESPEDEZA VIRGINICA (L.) Britton.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

LEUCAENA TRICHODES Benth.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LOTUS CAMPYLOCLADUS Webb & Berth.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs--Heal and coworkers (93).

LOTUS CORNICULATUS var. JAPONICUS Reg.

A water suspension of the leaves and flowers was ineffective against Drosophila hydei larvae, but a suspension of the leaves, stems, and roots was highly toxic to these larvae.--Yamaguchi and coworkers (233).

LOTUS PURSHIANUS (Benth.) Clements & Clements. Synonym: L. americanus.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

LOTUS SESSILIFOLIUS DC.

LOTUS WRIGHTII (A. Gray) Greene.

Aqueous extracts of the whole plant were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LUPINUS ANGUSTIFOLIUS L. Blue lupine.

The powdered seeds were nontoxic to melonworms, southern armyworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered seeds were nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds were nontoxic to celery leaf tiers, California oakworms, house flies, and codling moth larvae.--Jacobson (108).

LUPINUS LATIFOLIUS var. COLUMBIANUS (Heller) S. P. Sm.

LUPINUS MUTABILIS Sweet.

Aqueous extracts of the seeds of these species were nontoxic to German and American cockroaches and milkweed bugs. A chloroform extract of *L. mutabilis* seeds was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes. Alcohol and petroleum ether extracts of the seeds were nontoxic to all these insects.--Heal and coworkers (93).

LUPINUS NANUS Dougl.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LUPINUS PERENNIS L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LUPINUS sp.

An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MAACKIA AMURENSIS var. BUERGERI (Maxim.) Schneid.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MARMAROXYLON RACEMOSUM (Ducke) Killip.

An aqueous extract of the wood was nontoxic to German and American cockroaches. An alcohol extract of the wood was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

MEDICAGO LUPULINA L.

The plant showed little toxicity to silkworm and Mexican bean beetle larvae and bean aphids.--Lee and Hansberry (129).

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

MEDICAGO SATIVA L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the tops and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MELILOTUS ALBA Desr.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the upper parts was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MELILOTUS ALTISSIMA Thuill.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

MELILOTUS INDICA (L.) All.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs. An alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito.--Heal and coworkers (93).

MELILOTUS OFFICINALIS (L.) Lam. Melilot.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An acetone extract of the flowers was ineffective against mosquito larvae.--Hartzell (90).

MIMOSA ALBIDA Humb. & Bonpl.

An aqueous extract of the branches and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MIMOSA PUDICA L.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MIMOSA sp.

An aqueous extract of the roots and stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MORA GONGRIJPII (Kleinh.) Sandw.

The wood is very resistant to termites.--Wolcott (225).

MUCUNA PRURIENS (L.) DC. Synonym: Stizolobium pruriens.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

MUELLERA FRUTESCENS (Aubl.) Standl.

An aqueous extract of the fruits was toxic to American cockroaches and milkweed bugs, but not to German cockroaches. An alcohol extract of the fruits was toxic to milkweed bugs and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito, but not to German cockroaches and Anopheles mosquito larvae. A petroleum ether extract was toxic to milkweed bugs and larvae of the black carpet beetle and webbing clothes moth, but not to German cockroaches and Anopheles mosquito larvae. A chloroform extract was toxic to larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

MUELLERA sp.

A petroleum ether extract of the roots was toxic to the milkweed bug and larvae of the webbing clothes moth and black carpet beetle, but not to German cockroaches and Anopheles mosquito larvae. An alcohol extract of the roots was toxic to black carpet beetle larvae only. Alcohol and petroleum ether extracts of the stems and leaves were toxic to black carpet beetle larvae only. An alcohol extract of the shells was toxic to milkweed bugs and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito, but not to German cockroaches and Anopheles mosquito larvae.--Heal and coworkers (93).

MYROCARPUS FRONDOSUS Allem.

Aqueous extracts of the roots and of the stem bark were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MYROXYLON BALSAMUM (L.) Harms.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

MYROXYLON PEREIRAE (Royle) Kletzsch. Balsam of Peru.

An acetone solution of the oil was ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

NISSOLIA FRUTICOSA Jacq.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

NISSOLIA SCHOTTII A. Gray.

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ORMOSIOPSIS FLAVA Ducke.

An aqueous extract of the seeds was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

OSTRIODERRIS STUHLMANNII Dunn.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

OUGEINIA DALBERGIOIDES Benth.

An aqueous extract of the seeds was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PACHYRRHIZUS EROSUS (L.) Urban. Synonym: P. angulatus. Yam bean.

Pachyrrhizine, a substance obtained from ie alcohol extract of the seeds, was toxic red spiders, thrips, plant lice, white nats, and black gnats.--Bouillenne and oworkers (37).

The leaves are toxic to mosquito larvae.--ang (234).

The powdered seeds gave complete conol of silkworm and Mexican bean beetle rvae and bean aphids. Petroleum ether, etone, chloroform, carbon tetrachloride, d alcohol extracts all showed very high xicity to silkworm larvae and bean hids.--Lee and Hansberry (129).

The powdered seeds were toxic to bean aphids.--Chiu and coworkers (48).

The seed resin yielded rotenone, and at least two other components which were toxic to silkworm larvae but not to bean beetles.--Norton and Hansberry (161).

The powdered pods were ineffective against melonworms, fall armyworms, diamondback moths, and Cerotoma ruficornis, but a dust containing half seeds and half pods was toxic to all these species except Cerotoma.--Plank (173).

The ethyl ether extract of the seeds at 1 to 5,000 gave 100 percent kill of caterpillars in the fourth stage of the cabbage butterfly, Crocidolomia binotalis. A suspension of powdered seeds at 1 to 1,000 in water was more toxic than derris.--Meyer (147).

The seeds contain 25 percent of an oil which can be removed by extraction to make feasible the grinding of an insecticidal dust. The properties of the seed and oil are given.--Jakobs (111).

Aqueous suspensions of the seeds were toxic to adults of the cotton stainer and the green stink bug and to larvae of the China-grass butterfly.--Chiu (47).

The powdered seeds were toxic to melonworms, imported cabbageworms, diamondback moths, and pickleworms, but not to southern armyworms, cabbage loopers, celery tiers, cross-striped cabbageworms, and striped blister beetles.--Bottger and Jacobson (36).

The ripe fruits were highly toxic, both as a stomach and as a contact poison, to melonworm larvae. As a contact poison, they were also toxic to cotton stainer adults but relatively nontoxic to Australian cockroach nymphs. As stomach poisons, the fruits and the powdered leaves had no effect on bean leaf beetle adults. The stems showed some toxicity to melonworm larvae and cotton stainer adults but were inert to bean leaf beetle adults and Australian cockroach nymphs. The powdered roots showed fair toxicity to melonworm larvae and cotton stainer adults but were ineffective against bean leaf beetle adults and Australian cockroach nymphs. The seeds plus 50 percent pods were highly toxic to melonworm, fall armyworm, and diamondback moth larvae but were inert to bean leaf beetle, cotton stainer, and rice weevil adults, and to American cockroach nymphs. The powdered pods were inert to melonworm, fall armyworm, and diamondback moth larvae, and to bean leaf beetle adults.--Plank (174).

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An aqueous extract of the seeds was nontoxic to these insects and to milkweed bugs. Alcohol and chloroform extracts of the seeds were toxic to black carpet beetle and Aedes mosquito larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. A petroleum ether extract of the seeds was toxic to milkweed bugs and black carpet beetle larvae, but not to German cockroaches and webbing clothes moth larvae.--Heal and coworkers (93).

PACHYRRHIZUS PALMATILOBUS (Moc. & Sessé) Benth. & Hook.

The powdered seeds plus 50 percent pods were rather toxic, as a stomach poison, to melonworm and fall armyworm larvae, but ineffective against diamondback moth larvae and bean leaf beetle and rice weevil adults. As a contact poison, this material was highly toxic to melonworm larvae and fairly toxic to cotton stainer adults, but inert to American cockroach nymphs. The powdered pods were inert to melonworm and fall armyworm larvae, bean leaf beetle adults, and American cockroach nymphs.--Plank (174).

An aqueous extract of the branches and leaves was toxic to German cockroaches and slightly toxic to American cockroaches.--Heal and coworkers (93).

PACHYRRHIZUS TUBEROSUS (Lam.) Spreng.

The powdered seeds of the red and black varieties were toxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

The seeds of the red variety were toxic to the aphid, Brevicoryne brassicae.--Le Page and coworkers (130).

PACHYRRHIZUS spp.

A mixture composed of finely-ground seeds of P. ahipa, P. erosus, P. palmatilobus, or P. tuberosa or their extracts plus pyrethrins has been patented for use in insecticidal sprays and dusts.--Geary (71).

PARKIA NITIDA Miq.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PELTOGYNE LECOINTEI Ducke. Brazilian purpleheart.

The wood is resistant to termites.--Wolcott (225).

PELTOGYNE PUBESCENS Benth.

The wood is very resistant to termites.--Wolcott (225).

PELTOPHORUM SURINGARI Urb.

An aqueous extract of the roots was toxic to German cockroaches but not to American cockroaches and milkweed bugs. Alcohol and chloroform extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. A petroleum ether extract was toxic to webbing clothes moth and black carpet beetle larvae only.--Heal and coworkers (93).

PENTACLETHRA MACROLOBA (Willd.) Kuntze.

An aqueous extract of the seeds was very toxic to American cockroaches and milkweed bugs, but not to German cockroaches. An alcohol extract of the seeds was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A petroleum ether extract was nontoxic to all these insects. An aqueous extract of the stem bark was toxic to American cockroaches, but not to German cockroaches and milkweed bugs. Petroleum ether and chloroform extracts of the stem bark were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract was nontoxic to all these insects. A petroleum ether extract of the bark was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and webbing clothes moth larvae.--Heal and coworkers (93).

PENTACLETHRA MACROPHYLLA Benth

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PERALTEA ERYTHRINAEFOLIA Saldanha da Gama.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PETALOSTEMUM CANDIDUM (Willd.) Michx.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PETERIA SCOPARIA A. Gray.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PHASEOLUS LATHYROIDES L.

The plant was ineffective against house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

PHASEOLUS VULGARIS L.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PHYSOSTIGMA VENENOSUM Balf. Calabar bean.

An acetone extract of the seeds was ineffective against mosquito larvae.--Hartzell (90).

PIPTADENIA AFRICANA Hook.

An aqueous extract of the wood was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract of the wood was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and _Anopheles_ mosquito. Petroleum ether and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

PIPTADENIA RIGIDA Benth.

Aqueous extracts of the stem bark and of the fruits were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PIPTADENIA sp.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches, but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PISCIDIA ACUMINATA (Blake) I. M. Johnston.

The powdered roots were highly toxic to melonworm and diamondback moth larvae, but were ineffective against bean leaf beetle and cotton stainer adults and Australian cockroach nymphs. The powdered leaves were appreciably toxic to melonworm and diamondback moth larvae, but were inert to bean leaf beetle and cotton stainer adults and Australian cockroach nymphs. The bark showed some toxicity to melonworm larvae, but both the bark and the wood were inert to bean leaf beetle and cotton stainer adults and Australian cockroach nymphs. The wood was also inert to melonworm larvae.--Plank (174).

PISCIDIA CARTHAGENENSIS Jacq. Lengua gorda, barbasco.

The powdered bark was nontoxic to melonworms, southern armyworms, and southern beet webworms.--Bottger and Jacobson (36).

A petroleum ether extractive of the bark was nontoxic to German cockroaches, house flies, and codling moth larvae. Chloroform, ethyl ether, and alcohol extracts all showed some toxicity to codling moth larvae but not to house flies.--Jacobson (108).

PISCIDIA GRANDIFOLIA (Donn. Smith) I. M. Johnston. Synonym: _Ichthyomethia grandifolia_.

The crushed bark or fresh leaves are used in El Salvador against bedbugs.--Wellman and van Severen (221).

PISCIDIA PISCIPULA (L.) Sarg. Synonyms: _Ichthyomethia piscipula_, _P. erythrina_. Jamaica dogwood.

An acetone extract of the bark was ineffective against mosquito larvae.--Hartzell (90).

The powdered roots were highly toxic, both as stomach and contact poisons, to melonworm larvae. As a stomach poison,

the roots showed considerable toxicity to diamondback moth larvae but had no effect on bean leaf beetle adults. As a contact poison, the roots were toxic to cotton stainer adults but inert to Australian cockroach nymphs. The bark and the wood, as stomach poisons, were very toxic to melonworm and diamondback moth larvae, but ineffective against bean leaf beetle adults. The bark and wood, as contact poisons, were highly toxic to melonworm larvae and ineffective against cotton stainer adults and Australian cockroach nymphs. The leaves were toxic to melonworm and diamondback moth larvae but not to bean leaf beetle and cotton stainer adults and Australian cockroach nymphs.--Plank (174).

Rotenone was isolated from the root bark and the root wood.--Russell and Kaczka (189).

The powdered stems were toxic to southern beet webworms, but nontoxic to southern armyworms, melonworms, Hawaiian beet webworms, and yellow woolybears. The powdered roots were nontoxic to southern armyworms but toxic to the other insect species mentioned. The powdered leaves were toxic to southern beet webworms and Hawaiian beet webworms only.--Sievers and coworkers (197).

An acetone extract of the roots was highly toxic to mosquito larvae.--Jacobson (108).

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs. Alcohol and petroleum ether extracts of the bark were toxic to milkweed bugs and larvae of the black carpet beetle and webbing clothes moth (the alcohol extract was also toxic to Aedes and Anopheles mosquito larvae), but not to German cockroaches and Anopheles mosquito larvae. A chloroform extract of the bark was toxic to webbing clothes moth, black carpet beetle, and Aedes mosquito larvae and nontoxic to German cockroaches, milkweed bugs, and Anopheles mosquito larvae.--Heal and coworkers (93).

The powdered leaves were toxic to southern armyworms, melonworms, and southern beet webworms. The powdered roots were toxic to melonworms and southern beet webworms but not to southern armyworms. The powdered stems were toxic to melonworms only.--Bottger and Jacobson (36).

PISCIDIA sp.

The powdered stem bark was toxic to southern armyworms, melonworms, and southern beet webworms, but not to sweetpotato weevils.--Bottger and Jacobson (36).

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PITCHERIA GALACTIOIDES Nutt.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PITHECELLOBIUM ALBICANS Benth.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PITHECELLOBIUM ALEXANDRI Urb.

An aqueous extract of the wood was slightly toxic to American cockroaches and nontoxic to German cockroaches. An alcohol extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and webbing clothes moth and Aedes mosquito larvae.--Heal and coworkers (93).

PITHECELLOBIUM TRAPEZIFOLIUM Benth.

The powdered leaves were highly toxic to silkworm larvae but nontoxic to Mexican bean beetle larvae, potato aphids, and bean aphids.--Hansberry and Clausen (86).

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PITHECOLOBIUM RACEMOSUM Ducke. Surinam snakewood.

The wood is resistant to termites.--Wolcott (225).

PLATYMISCIUM ULEI Harmes. Synonym: P. paracense. Letterwood.

The wood is very resistant to termites.--Wolcott (225).

PLATYSCYAMUS REGNELLII Benth.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

POIRETIA TETRAPHYLIA (Poir.) Burkart.

Extracts of the leaves were highly toxic to Schizaphis graminum.--Nico and Cambet (160).

PONGAMIA PINNATA (L.) Wight.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PRIORIA COPAIFERA Griseb. Cativo.

The wood of this tree is subject to attack by termites and other insects, and, in salt water, to the attack of teredo or other marine borers.--Wolcott (224).

PROSOPIS JULIFLORA (Sw.) DC. Mesquite.

The wood is susceptible to termites.--Wolcott (225).

PROSOPIS JULIFLORA var. VELUTINA (Woot.) Sarg.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PROSOPIS KUNTZEI Harms.

An aqueous extract of the fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PROSOPIS STEPHANIANA Kunth.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Aqueous extracts of the fruits and of the roots were nontoxic to these insects.--Heal and coworkers (93).

PSORALEA GLANDULOSA L.

An aqueous extract of the tops and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A petroleum ether extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and webbing clothes moth and Anopheles mosquito larvae. Alcohol and chloroform extracts were nontoxic to these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

PSORALEA LANCEOLATA Pursh.

An aqueous extract of the branchlets, leaves, and flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PSORALEA ONOBRYCHIS Nutt.

An aqueous extract of the upper parts was nontoxic to German and American cockroaches. An aqueous extract of the seeds was slightly toxic to American cockroaches only.--Heal and coworkers (93).

PSORALEA TENUIFLORA Pursh.

An aqueous extract of the above-ground portion was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PTEROCARPUS INDICUS Willd.

An aqueous extract of the wood was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PTERODON PUBESCENS Benth.

An aqueous extract of the branchlets and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PUERARIA YUNNANENSIS Franch.

The powdered roots showed fair toxicity to silkworm and Mexican bean beetle larvae, but had no effect on bean aphids. Petroleum ether, ethyl ether, alcohol, chloroform, carbon tetrachloride, and acetone extracts had no effect on silkworm larvae and bean aphids. The powdered stems showed some toxicity to Mexican bean beetle larvae but had no effect on silkworm larvae and bean aphids. An alcohol extract of the stems had no effect on silkworm larvae and bean aphids, and chloroform

and acetone extracts had no effect on bean aphids.--Lee and Hansberry (129).

The powdered roots were toxic to bean aphids.--Chiu and coworkers (48).

RHYNCOSIA TEXANA T. & G.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

RHYNCOSIA sp.

An aqueous extract of the seeds was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

ROBINIA HISPIDA L.

The powdered leaves and stems were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ROBINIA PSEUDOACACIA L. Black locust.

The wood is resistant to termites.--Wolcott (225).

The powdered leaves, seeds, and pods were each nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An acetone extract of the bark was ineffective against mosquito larvae.--Hartzell (90).

The heartwood of this tree is very resistant to termites.--Scheffer and Duncan (191).

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ROBINIA VISCOSA Vent.

The powdered leaves and stems were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SABINEA PUNICEA Urb.

Aqueous extracts of the branches and of the roots were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SAMANEA SAMAN (Jacq.) Merr. Cenisero, rain-tree.

The wood is resistant to termites.--Wolcott (225).

SCHRANKIA CHAPMANII (Small) F. J. Hermann. Synonym: Leptoglottis chapmanii.

An aqueous extract of the tops was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SCHRANKIA MICROPHYLLA (Dryand.) Macbr. Synonym: Leptoglottis microphylla.

An aqueous extract of the branchlets, leaves, and roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SESBANIA GRANDIFLORA (L.) Pers.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches. An extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SESBANIA SERICEA (Willd.) Link.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

SOPHORA AFFINIS T. & G.

The powdered berries and their extracts were nontoxic to armyworms, pea aphids, and celery leaf tiers.--Bottger and Jacobson (36).

The powdered berries were ineffective against European corn borer larvae. Petroleum ether, ethyl ether, chloroform, and alcohol extractives of the berries were all nontoxic to house flies.--Jacobson (108).

Aqueous extracts of the fruits, the branchlets and leaves, and the roots were all toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SOPHORA FLAVESCENS Ait. Synonym: S. angustifolia.

The roots are used as an insecticide in China. The powdered seeds showed little toxicity to silkworm and Mexican bean beetle larvae and bean aphids.--Lee and Hansberry (129).

The powdered roots were toxic to bean aphids.--Chiu and coworkers (48).

The roots were toxic to black cucurbit beetles.--Chiu (47).

An acetone extract of the roots was toxic to Culex pipiens larvae. The toxicity was traced to the basic part of the extract.--Yamaguchi and coworkers (232).

SOPHORA JAPONICA L.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SOPHORA SECUNDIFLORA (Orteg.) Lag. Coral bean.

The powdered seeds were toxic to armyworms but not to celery leaf tiers, pea aphids, and two-spotted spider mites. Pyrax dusts of both petroleum ether and alcohol extractives of the seeds were nontoxic to these insects.--Bottger and Jacobson (36).

The powdered seeds and pods were ineffective against European corn borer larvae. Petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds and pods were nontoxic to house flies. Petroleum ether and alcohol extractives were ineffective against cat fleas, lone star ticks, chiggers, body lice, and Anopheles mosquito larvae, and as body louse ovicides. Extracts of the bark were nontoxic to house flies.--Jacobson (108).

An aqueous extract of the seeds was very toxic to German and American cockroaches, while an aqueous extract of the seed kernels was nontoxic to German cockroaches.--Heal and coworkers (93).

SOPHORA SERICEA Nutt.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs. Aqueous extracts of the roots were very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Petroleum ether and chloroform extracts of the tops and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract of the tops and leaves was nontoxic to all these insects.--Heal and coworkers (93).

SOPHORA TETRAPTERA J. Mill. Synonym: S. macrocarpa.

Aqueous extracts of the seeds and of the fruits were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SOPHORA TOMENTOSA L.

Although aqueous extracts of one sample of seeds were nontoxic to German and American cockroaches and milkweed bugs, aqueous extracts of several different samples of seeds were toxic to American cockroaches.--Heal and coworkers (93).

SPATHOLOBUS ROXBURGHII Benth.

An acetone extract of the bark was toxic to mosquito larvae.--Jacobson (108).

STAHLIA MONOSPERMA (Tul.) Urban.

The wood is resistant to termites.--Wolcott (225).

STROPHOSTYLES HELVOLA (L.) Ell.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

STRYPHNODENDRON BARBATIMAM Mart.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

STYLOSANTHES BIFLORA (L.) B. S. P.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SWAINSONA LUTEOLA F. Muell.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SWARTZIA LEIOCALYCINA Benth.

The wood is resistant to termites.--Wolcott (225).

SWARTZIA MADAGASCARIENSIS Desv.

The powdered fruit of this African legume is used to stupefy fish and keep termites away. The pericarp contains no rotenone.--Beauquesne (30).

SWARTZIA TOMENTOSA DC.

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

SWEETIA PANAMENSIS Benth. Guayacan.

The heartwood of this tree from Costa Rica is very resistant to termites.--Scheffer and Duncan (191).

TAMARINDUS INDICUS L. Tamarind.

The wood is very susceptible to termites.--Wolcott (225).
An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

TETRAMNUS LABIALIS Spreng.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

THERMOPSIS MACROPHYLLA Hook.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

THERMOPSIS MOLLIS M. A. Curt.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

THERMOPSIS MONTANA Nutt.

An aqueous extract of the upper parts was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TRIFOLIUM AGRARIUM L.

TRIFOLIUM ARVENSE L.

TRIFOLIUM CAMPESTRE Schreb. Synonym: *T. procumbens*.

TRIFOLIUM DUBIUM Sibth.

TRIFOLIUM HYBRIDUM L.

TRIFOLIUM PRATENSE L.

TRIFOLIUM REPENS L.

The powdered plants were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

TRIFOLIUM PERUVIANUM Vog.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TRIGONELLA FOENUM-GRAECUM L. Foenugreek.

An acetone extract of the seeds was ineffective against mosquito larvae.--Hartzell (90).
An aqueous extract of the seed fragments was toxic to milkweed bugs, slightly toxic to American cockroaches, and nontoxic to German cockroaches.--Heal and coworkers (93).

VATAIREA GUIANENSIS Aubl.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

VATAIREOPSIS SPECIOSA Ducke.

An aqueous extract of the wood was nontoxic to German and American cockroaches. An alcohol extract of the wood was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and *Aedes* mosquito.--Heal and coworkers (93).

VICIA AMERICANA Muhl.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

VICIA CRACCA L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

An aqueous suspension of the leaves was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

VICIA DASYCARPA Ten.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

VICIA JAPONICA A. Gray.

An aqueous suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

VICIA SATIVA L.

An aqueous extract of the seeds was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An alcohol extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Petroleum ether and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

VICIA TETRASPERMA (L.) Moench.

VICIA VILLOSA Roth.

The powdered plants were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

VIGNA SINENSIS Savi.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

WILLARDIA MEXICANA (S. Wats.) Rose.

The powdered bark and wood were both effective against Autographa 00, cross-striped cabbageworms, melonworms, and southern armyworms. A 10-percent talc dust of an aqueous extract of the bark was toxic to cross-striped cabbageworms, but not to bean leaf rollers, cabbage loopers, melonworms, and southern armyworms. The powdered stems and bark were toxic to Hawaiian beet webworms, melonworms, and southern armyworms, but not to cross-striped cabbageworms.--Bottger and Jacobson (36).

The plant is reported to be used as a parasiticide in Mexico. The powdered stems and bark were ineffective against European corn borers, but showed some toxicity to body lice. A petroleum ether extractive of the combined stems and bark was slightly toxic to house flies. Ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies and German cockroaches. Combined petroleum ether and ethyl ether extractives of the stems and bark were somewhat toxic to codling moth larvae. Petroleum ether extractives of the bark and of the wood both showed some toxicity to house flies. Hot water extractives of the bark and of the wood were nontoxic to screwworm and codling moth larvae, but they were quite toxic to Ixodes ticks. A water extractive of the wood was nontoxic to cattle grubs.--Jacobson (108).

An aqueous extract of the bark was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A petroleum ether extract of the bark was toxic to milkweed bugs and larvae of the black carpet beetle and webbing clothes moth, but nontoxic to German cockroaches and Anopheles mosquito larvae. Alcohol and chloroform extracts were toxic to black carpet beetle larvae only. Petroleum ether extracts of the leaves and of the stem bark were toxic to milkweed bugs and black carpet beetle larvae only.--Heal and coworkers (93).

WISTERIA FRUTESCENS (L.) Poir. American wisteria.

An acetone extract of the seeds showed some toxicity to codling moth larvae and German cockroach nymphs and adult males, but not to German cockroach adult females.--Jacobson (108).

WISTERIA SINENSIS (Sims.) Sweet. Chinese wisteria.

An acetone extract of the seeds showed some toxicity to codling moth larvae.--Jacobson (108).

WISTERIA sp.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ZOLLERNIA PARAENSIS Huber.

The wood is very resistant to termites.--Wolcott (225).

ZORNIA DIPHYLLA (L.) Pers.

An aqueous extract of the whole plant was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

LENTIBULARIACEAE

UTRICULARIA MACRORHIZA Leconte.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LILIACEAE

ALETRIS FARINOSA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ALLIUM CEPA L. Onion.

Ixodes ticks exposed to vapors of onion bulbs died in several days. When placed in onion juice, the ticks died in 40 minutes.--Olenev (162).

ALLIUM MONANTHUM Maxim.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae, but a suspension of the roots was nontoxic to these larvae.--Yamaguchi and coworkers (233).

ALLIUM NIPPONICUM Franch. et Swat.

Water suspensions of the flowers and of the leaves, stems, and roots were toxic to Drosophila hydei larvae, but a suspension of the seeds was nontoxic to these larvae.--Yamaguchi and coworkers (233).

ALLIUM ODORUM L.

A water suspension of the leaves was fairly toxic to Drosophila hydei larvae, and a suspension of the roots was highly toxic to the larvae.--Yamaguchi and coworkers (233).

ALLIUM SATIVUM L. Garlic.

Ixodes ticks exposed to the vapors of powdered garlic bulbs died in 25 minutes.--Olenev (162).

ALLIUM SCHOENOPRASUM L. Chive.

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

ALLIUM SCORODOPRASUM var. VIVIPARUM Regel.

An acetone extract of the roots and stems was toxic to Culex pipiens larvae. The toxicity was traced to the water-insoluble portion of the extract.--Yamaguchi and coworkers (232).

ALOE FEROX Mill.

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

ALOE PERRYI Baker. Aloes.

Acetone and water extracts of the whole plant were ineffective against mosquito larvae.--Hartzell (89).

AMIANTHEMUM MUSCAETOXICUM (Walt.) A. Gray. Crow poison.

The powdered leaves and the powdered roots and bulbs were both slightly toxic to southern beet webworms but not to melonworms and southern armyworms.--Bottger and Jacobson (36).

The powdered leaves and the powdered bulbs were both toxic to European corn borer larvae. Combined petroleum ether and ethyl ether extractives and an alcohol extractive of the leaves were toxic to codling moth larvae but not to house flies. Combined petroleum ether, ethyl ether, chloroform and alcohol extractives of the roots and bulb were toxic to codling moth larvae but not t German cockroaches.--Jacobson (108).

Aqueous extracts of the bulbs and of th leaves were toxic to American cockroache when injected into the blood stream, bu German cockroaches and milkweed bug

were unaffected after immersion in the extracts. An alcohol extract of the bulbs was toxic to black carpet beetle and Aedes mosquito larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. A petroleum ether extract was toxic to black carpet beetle larvae only. A chloroform extract was toxic to milkweed bugs and larvae of the black carpet beetle and Aedes mosquito. Extracts of the leaves gave the same results, except that they were nontoxic to milkweed bugs. Alcohol and petroleum ether extracts of the whole plant were toxic to black carpet beetle larvae only, while a chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

ANTHERICUM CHANDLERI Greenm. & Thomps.

Aqueous extracts of the roots and of the tops were both toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ASPARAGUS OFFICINALIS L. Asparagus.

An acetone extract of the seeds was ineffective against mosquito larvae.--Hartzell (90).

ASTELLIA CUNNINGHAMII Hook.

An aqueous extract of the fruits was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the tops was nontoxic to these insects. Alcohol, petroleum ether, and chloroform extracts of the fruits were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito--Heal and coworkers (93).

ASTELLIA NERVOSA Banks & Soland.

An aqueous extract of the tops was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BLOOMERIA CLEVELANDII S. Wats.

An aqueous extract of the bulbs was toxic to German and American cockroaches but not to milkweed bugs.--Heal and coworkers (93).

BULBINE BULBOSA Haw.

An aqueous extract of the corms was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CAMASSIA QUAMASH (Pursh) Greene.

Alcohol and petroleum ether extracts of the fresh bulbs were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

CHLOROGALUM POMERIDIANUM (DC.) Kunth. Soaproot.

The powdered bulbs were toxic to armyworms and melonworms, but relatively nontoxic to bean leaf rollers, cross-striped cabbageworms, Hawaiian beet webworms, and large milkweed bugs.--Bottger and Jacobson (36).

The powdered bulbs were ineffective against European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the bulbs were nontoxic to codling moth larvae and house flies.--Jacobson (108).

An aqueous extract of the bulbs was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CLINTONIA BOREALIS (Ait.) Raf.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the leaves were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

COLCHICUM AUTUMNALE L. Meadow saffron.

An acetone extract of the seeds was toxic to mosquito larvae, but an extract of the roots was nontoxic to the larvae.--Hartzell (90).

CONVALLARIA MAJALIS L. Lily-of-the-valley.

Acetone and water extracts of the leaves were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the whole plant was highly toxic to American cockroaches and milkweed bugs, but not to German cockroaches. Alcohol and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. A petroleum ether extract was nontoxic to all these insects.--Heal and coworkers (93).

DASYLIRION LEIOPHYLLUM Engelm.

A dust of the alcohol extract of the leaves was nontoxic to armyworms, pea aphids, two-spotted spider mites, and large milkweed bugs.--Jacobson (108).

DASYLIRION WHEELERI S. Wats.

A dust of the alcohol extract of the combined leaves and flower heads was nontoxic to armyworms, pea aphids, two-spotted spider mites, and large milkweed bugs.--Jacobson (108).

DIPCADI GLAUCUM Baker.

An aqueous extract of the bulbs was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

DRACAENA FRAGRANS Ker.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ERYTHRONIUM GRANDIFLORUM Pursh.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ERYTHRONIUM JAPONICUM Makino.

Water suspensions of the leaves and of the roots were highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

FRITILLARIA PARVIFLORA Torr.

An aqueous extract of the bulbs was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

FRITILLARIA PUDICA (Pursh.) Spreng.

An aqueous extract of the bulbs was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HELONIAS BULLATA L.

An aqueous extract of the bulbs was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the tops was nontoxic to these insects. Alcohol, petroleum ether, and chloroform extracts of the bulbs were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

HEMEROCALLIS FULVA L.

An aqueous extract of the upper parts was nontoxic to American cockroaches.--Heal and coworkers (93).

HERRERIA MONTEVIDENSIS Klotzsch.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LEUCROCRINUM MONTANUM Nutt.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

LILIUM CORDIFOLIUM Thunb.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

LILIUM SUPERBUM L.

An aqueous extract of the bulbs was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after

immersion in the extract.--Heal and coworkers (93).

LUZURIAGA MARGINATA (Lam.) Benth. & Hook.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MEDEOLA VIRGINIANA L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MELANTHIUM VIRGINICUM L.

An aqueous extract of the bulbs was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

NARTHECIUM CALIFORNICUM Baker.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

NOLINA sp.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

NOTHOSCORDUM ARIZONICUM.

NOTHOSCORDUM BIVALVE (L.) Britton.

Aqueous extracts of the bulbs were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

NOTHOSCORDUM TEXANUM M. E. Jones.

An aqueous extract of the bulbs was highly toxic to German and American cockroaches, but nontoxic to milkweed bugs.--Heal and coworkers (93).

ORNITHOGALLUM UMBELLATUM L.

Aqueous extracts of the bulbs and of the bulbs and leaves were both highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol, petroleum ether, and chloroform extracts of the bulbs were toxic to black carpet beetles, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

PARIS TETRAPHYLLA A. Gray.

A water suspension of the leaves was nontoxic to Drosophila hydei larvae, but a suspension of the combined leaves, stems, and roots was highly toxic to the larvae.--Yamaguchi and coworkers (233).

PARIS VERTICILLEATA Bieb.

A water suspension of the combined leaves, stems, and roots was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

POLYGONATUM BIFLORUM (Watt.) Ell.

An aqueous extract of the underground parts was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

POLYGONATUM CANALICULATUM (Muhl.) Pursh.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

POLYGONATUM JAPONICUM C. Morr. & Decne.

Water suspensions of the roots and of the flowers were nontoxic to Drosophila hydei larvae, but a suspension of the leaves was highly toxic to the larvae.--Yamaguchi and coworkers (233).

SANSEVIERIA THYRSIFLORA Thunb.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

SCHOENOCAULON DRUMMONDII A. Gray.

The seeds were highly toxic to house flies. No toxicity was found in the roots, bulbs, leaves, or stems.--Allen and coworkers (10).

SCHOENOCAULON OFFICINALE A. Gray.
Synonyms: Asagraea officinalis, Helonias officinalis, Sabadilla officinarum, Veratrum officinale. Sabadilla.

A sabadilla spray is effective in the control of house flies.--Allen and Dicke (8).

Kerosene extracts of the seeds were highly toxic to house flies, but considerable variation existed in the toxicity of extracts of the different samples. By raising the extractive temperature, all inactive samples became potentially toxic. Temperature levels above 75° C. caused the initial increase in toxicity, the optimum temperature being 150° C. Application of heat to the powdered seed and treatment of the seed with soda ash prior to extraction also increased toxicity to a considerable degree. The toxicity of the powdered seed increased with age during storage.--Allen and coworkers (9).

Veratridine was found to be a very highly toxic constituent of the seeds. Cevine and the seed oil were nontoxic to house flies, but the oil possessed knockdown power. Both veratridine and cevadine, as well as mixtures of the remaining alkaloids, gave quick and complete knockdown of house flies. Cevine and cevine dibenzoate showed no toxicity in kerosene to house flies.--Ikawa and coworkers (104).

In tests against the milkweed bug and the red-legged grasshopper using the alkaloids, cevadine was found to be most toxic, veratridine and the hydrochlorides of veratrine possessed considerably less toxicity, and cevine and the oil obtained by petroleum ether extraction were nontoxic. --Allen and coworkers (10).

Tests against the large milkweed bug and the red-legged grasshopper showed that the activation of sabadilla dusts with heat or alkali appreciably increased the toxicity.--Allen and Brunn (7).

Sabadilla was ineffective in the control of pear psylla.--Hamilton (85).

An acetone extract of the seeds was toxic to mosquito larvae.--Hartzell (90).

Cevadine and veratrine were tested against 49 insect species and found to be highly toxic.--Velbinger (215).

A product from Lima, Peru consisting of powdered sabadilla, Chili pepper, arsenic, and quicklime was tested against insects. The material was completely toxic to diamondback moth larvae. An acetone extract of this material was very toxic to bean aphids, diamondback moth larvae, tomato moth larvae, and mustard beetle adults, but it was less toxic to the beetle Ahasverus advena.--Tattersfield and coworkers (209).

Some of the mixed alkaloidal fractions obtained were very toxic to the large milkweed bug, while others were much less toxic to this insect.--Poetsch and Parks (176).

In tests with house flies, tarnished plant bugs, and alfalfa plant bugs, a synergistic relationship was found to exist between sabadilla and DDT.--Medler and Thompson (146).

Sabadilla gave no control of green peach aphids and turnip aphids.--Walton (217).

A 1:1 mixture of seed and talc was toxic to armyworms, cabbage loopers, melonworms, and squash bugs.--Bottger and Jacobson (36).

Veratrine was very toxic to southern armyworms, blister beetles, greenhouse leaf tiers, melonworms, European corn borers, and codling moth larvae. An alkaloid or alkaloidal mixture from a commercial sample of seed was one-half as effective as pyrethrins against house flies when tested at 1 milligram per milliliter of 20 percent acetone: Deobase.--Jacobson (108).

An aqueous extract of the seeds was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An alcohol extract was toxic to black carpet beetle and webbing clothes moth larvae, but not to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae. A petroleum ether extract was toxic to black carpet beetle larvae only.--Heal and coworkers (93).

SCHOENOCAULON TEXANUM (Scheele) A. Gray.

The seeds were highly toxic to house flies. No toxicity was found in the roots, bulbs, leaves, or stems.--Allen and coworkers (10).

SCILLA SCILLOIDES (Lindl.) Druce.

Water suspensions of the roots and of the combined leaves and roots were nontoxic to Drosophila hydei larvae, but a suspension of the combined leaves and stems was toxic to the larvae.--Yamaguchi and coworkers (233).

SCILLA THUNBERGII Miyabe & Kudo.

The powdered root was nontoxic to southern armyworms and southern beet webworms.--Bottger and Jacobson (36).

SMILACINA RACEMOSA (L.) Desf.

An aqueous extract of the leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SMILAX HERBACEA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SMILAX ORNATA Lem.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SMILAX SIEBOLDI Miq.

A water suspension of the seeds was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

SMILAX SYPHILITICA.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SMILAX sp.

The powdered root was nontoxic to cabbage loopers, melonworms, and southern armyworms.--Bottger and Jacobson (36).

The powdered root was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies and codling moth larvae.--Jacobson (108).

STENANTHIUM ROBUSTUM S. Wats.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

STYPANDRA GLAUCA R. Br.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TOFIELDIA CALYCULATA (L.) Wahl.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TOFIELDIA OCCIDENTALIS S. Wats.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TRILLIUM CHLOROPETALUM (Torr.) Howell.

An aqueous extract of the roots was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and webbing clothes moth larvae. A chloroform extract was toxic to black carpet beetle larvae only.--Heal and coworkers (93).

TRILLIUM ERECTUM L. Beth.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.

Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

UVULARIA GRANDIFLORA Sm.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

VERATRUM ALBUM L. European white hellebore.

Veratrine was tested against 49 insect species and found to be highly toxic.--Velbinger (215).

A hot water decoction of the rhizomes, applied to the backs of cattle, was very effective against warble-fly larvae.--Priselkov and coworkers (177).

Aqueous infusions and strong alcohol extracts of this plant, emulsified with water, were toxic to lice, flies, mosquitoes, and bugs (bedbugs?).--Petrischeva (172).

Hot water decoctions of the roots or rhizomes were effective against mange mites on domestic animals.--Nanobashvili (158).

The powdered root was toxic to melonworms but not to southern armyworms and cabbage loopers.--Bottger and Jacobson (36).

An aqueous extract of the roots was very toxic to German and American cockroaches. An alcohol extract of the whole plant was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A petroleum ether extract of the whole plant was toxic to black carpet beetle larvae and milkweed bugs, but not to German cockroaches and larvae of the webbing clothes moth and Anopheles mosquito.--Heal and coworkers (93).

VERATRUM CALIFORNICUM Durand.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

VERATRUM DAHURICUM (Turcz.) O. Loes.

Aqueous infusions and strong alcohol extracts of this plant, emulsified with water, were toxic to lice, flies, mosquitoes, and bugs (bedbugs?).--Petrischeva (172).

VERATRUM ESCHSCHOLTZII A. Gray.

An aqueous extract of the roots was toxic to German and American cockroaches.--Heal and coworkers (93).

VERATRUM GRANDIFLORUM (Maxim.) O. Loes.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

VERATRUM JAPONICUM var. REYMONDIANUM.

A water suspension of the combined leaves, stems, and seeds was highly toxic to Drosophila hydei larvae, but a suspension of the combined leaves, stems, flowers, and roots was nontoxic to these larvae.--Yamaguchi and coworkers (233).

VERATRUM MAXIMOWICZII Baker.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

VERATRUM NIGRUM L. Black hellebore.

Water infusions and strong alcohol extracts of the plant, emulsified with water, were toxic to lice, flies, mosquitoes, and bugs (bedbugs?).--Petrischeva (172).

A water suspension of the stems or rhizomes gave 90 percent knockdown of house flies, but a suspension of the leaves was ineffective.--Hwang (102).

The stems and rhizomes are used in China as baits for house flies. An acetone extract of the rhizomes was effective against tent caterpillars but not against cotton aphids.--Chiu (47).

The crushed bulbs are soaked in rice soup or hot water for several days and the extract is made up to a 5-percent solution which is toxic to house flies. The fresh and dry bulbs are equally toxic. The bulbs and roots are more toxic than the leaves.--Hwang (101).

VERATRUM STAMINEUM var. GLABRUM.

A water suspension of the roots was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

An acetone extract of the roots and stems was toxic to Culex pipiens larvae. The toxicity was traced to the basic part of the extract.--Yamaguchi and coworkers (232).

VERATRUM VIRIDE Ait. American hellebore, green hellebore.

Jervine and pseudojervine, the predominant alkaloids, were toxic to American cockroaches.--Seiferle and coworkers (192).

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

The powdered roots were toxic to melonworms and Hawaiian beet webworms but not o southern armyworms, cabbage loopers, ean leaf rollers, cross-striped cabbage-worms, and imported cabbageworms. The owdered leaves and stems were toxic to nelonworms and Hawaiian beet webworms ut not to southern armyworms, cross-triped cabbageworms, and bean leaf ollers.--Bottger and Jacobson (36).

The powdered roots, but not the leaves nd stems, were toxic to European corn orer larvae. Combined petroleum ether, thyl ether, chloroform, and alcohol ex-ractives of the roots and of the stems and eaves were nontoxic to house flies but owed some toxicity to codling moth rvae.--Jacobson (108).

An aqueous extract of the tops and roots as slightly toxic to American cockroaches d nontoxic to German cockroaches and ilkweed bugs.--Heal and coworkers (93).

ERATRUM sp.

Powdered hellebore acts as a stomach ison. It rapidly loses its toxicity on posure to air.--Castagne (42).

ROPHYLLUM TENAX (Pursh.) Nutt.

An aqueous extract of the whole plant s slightly toxic to American cockroaches l toxic to German cockroaches.--Heal l coworkers (93).

CCA ALOIFOLIA L.

An aqueous extract of the leaves was hly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol and petroleum ether extracts of the leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was toxic to all these insects. Alcohol, petroleum ether, and chloroform extracts of the roots were nontoxic to all these insects.--Heal and coworkers (93).

YUCCA CARNEROSANA (Trel.) McKelvey.

YUCCA FAXONIANA (Trel.) Sarg.

Pyrophyllite dusts of alcohol extracts of the leaves of these species were nontoxic to armyworms, pea aphids, two-spotted spider mites, and large milkweed bugs.--Jacobson (108).

YUCCA LOUISIANENSIS Trel.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

YUCCA SCHIDIGERA Roezl. Synonym: Y. mojavensis. Spanish dagger.

The powdered leaves were toxic to melonworms, Hawaiian beet webworms, bean leaf rollers, and celery leaf tiers, but not to cross-striped cabbageworms.--Bottger and Jacobson (36).

Both the powdered leaves and an ethyl ether extractive thereof were nontoxic to codling moth larvae.--Jacobson (108).

YUCCA TORREYI Shafer.

Pyrophyllite dusts of alcohol extracts of the leaves were nontoxic to armyworms, pea aphids, two-spotted spider mites, and large milkweed bugs.--Jacobson (108).

YUCCA sp.

The saponin obtained from an unidentified species of Yucca was nontoxic to mosquito larvae and adult house flies.--Jacobson (108).

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ZIGADENUS ANGUSTIFOLIUS S. Wats.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A petroleum ether extract was nontoxic to all these insects.--Heal and coworkers (93).

ZIGADENUS GLAUCUS Nutt.

A chloroform extract of the bulbs was toxic to milkweed bugs and larvae of the black carpet beetle and webbing clothes moth, but not to German cockroaches and Aedes and Anopheles mosquito larvae.--Heal and coworkers (93).

ZIGADENUS PANICULATUS (Nutt.) S. Wats.

An aqueous extract of the bulbs and leaves was nontoxic to German and American cockroaches and milkweed bugs, but an extract of the tops and flowers was toxic to milkweed bugs, slightly toxic to American cockroaches, and nontoxic to German cockroaches. A chloroform extract of the bulbs was toxic to milkweed bugs and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito, but nontoxic to German cockroaches and Anopheles mosquito larvae. A petroleum ether extract of the tops and flowers was toxic to milkweed bugs only. A chloroform extract of the tops and flowers was nontoxic to Aedes and Anopheles mosquito larvae, and an alcohol extract was nontoxic to all these insects. A chloroform extract of the aboveground portions was toxic to black carpet beetle larvae only.--Heal and coworkers (93).

ZIGADENUS sp.

A petroleum ether extract of the bulbs and lower parts was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. A chloroform extract was toxic to milkweed bugs and black carpet beetles only. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

LIMNANTHACEAE

FLOERKEA PROSERPINACOIDES Willd.

LIMNANTHES ALBA Hartw.

Aqueous extracts of the whole plant were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

LINACEAE

LINUM CHAMISSONIS Schiede.

An aqueous extract of the whole plant was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LINUM USITATISSIMUM L. Flax, linseed.

An acetone extract of the seeds was ineffective against mosquito larvae.--Hartzell (90).

Linseed oil was not very promising against San José scale.--Viel (216).

LOASACEAE

MENTZELIA DECAPETALA (Pursh) Urban & Gilg.

An aqueous extract of the upper parts was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

LOBELIACEAE

ISOTOMA LONGIFLORA (L.) Presl.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LOBELIA INFLATA L. Lobelia.

Acetone and water extracts of the whole plant were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the whole plant was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

LOBELIA SIPHILITICA L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

LOBELIA TUPA L.

Aqueous extracts of the roots and of the tops were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LOGANIACEAE

ANTONIA OVATA Pohl.

The powdered leaves, bark, and wood each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

An aqueous extract of the leaves was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol extracts of the stems and leaves and of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* mosquito. Petroleum ether and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

ANTONIA OVATA var. PILOSA Progel.

The powdered wood was nontoxic to Mexican bean beetle larvae and only slightly toxic to silkworm larvae.--Hansberry and Clausen (86).

BUDDLEIA LINDLEYANA Fortune.

The powdered leaves showed little toxicity to silkworm and Mexican bean beetle larvae and to bean aphids.--Lee and Hansberry (129).

The powdered leaves were toxic to bean aphids.--Chiu and coworkers (48).

BUDDLEIA MADAGASCARIENSIS Lam.

An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BUDDLEIA PERFOLIATA H.B.K.

An aqueous extract of the branches, leaves, and flowers was nontoxic to German and American cockroaches.--Heal and coworkers (93).

BUDDLEIA RACEMOSA Torr.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BUDDLEIA SESSILIFLORA H.B.K.

An aqueous extract of the tops was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BUDDLEIA sp.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CYNOCTONUM MITREOLA (L.) Britton.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GELSEMIUM SEMPERVIRENS (L.) Ait. f.

An aqueous extract of the roots was nontoxic to German and American cockroaches. Alcohol and chloroform extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes. The petroleum ether extract was nontoxic to all these insects.--Heal and coworkers (93).

LABORDIA TINIFOLIA A. Gray.

An aqueous extract of the stems was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

NUXIA VERTICILLATA Lam.

An aqueous extract of the branches and bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

POLYPREMUM PROCUMBENS L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

POTALIA AMARA Aubl.

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SPIGELIA ANTHELMIA L.

Some of the plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

SPIGELIA HUMBOLDTIANA Cham. & Schlecht.

An aqueous extract of the roots was nontoxic to American cockroaches. Alcohol and petroleum ether extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was toxic to webbing clothes moth and black carpet beetle larvae only.--Heal and coworkers (93).

SPIGELIA MARILANDICA L.

An aqueous extract of the lower parts was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An alcohol extract was toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and Aedes mosquito larvae. A chloroform extract was toxic to webbing clothes moth and black carpet beetle larvae and to confused flour beetles. A petroleum ether extract was toxic to black carpet beetle larvae only. A chloroform extract of the roots was toxic to confused flour beetles and larvae of the webbing clothes moth and black carpet beetle, but not to German cockroaches, milkweed bugs, and Aedes mosquito larvae.--Heal and coworkers (93).

STRYCHNOS GUIANENSIS Baill.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

STRYCHNOS NUX-VOMICA L.

An acetone solution of the glycoside, loganin, was ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of an unidentified portion was nontoxic to American cockroaches.--Heal and coworkers (93).

STRYCHNOS sp.

A 1-percent solution of the alkaloid brucine, obtained from a species of Strychnos, prevented termite attack on treated wood for only one month.--Wolcott (224).

LORANTHACEAE

PHORADENDRON FLAVESCENS Nutt. Mistletoe.

An acetone extract of the leaves was toxic to mosquito larvae.--Hartzell (90).

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

PHORADENDRON VILLOSUM Nutt.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PSITTACANTHUS CUNEIFOLIUS Blume.

An aqueous extract of a sample of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of another sample of stems and leaves was nontoxic to all these insects.--Heal and coworkers (93).

VISCUM VENOSUM DC.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LYTHRACEAE

AMMANNIA COCCINEA Rottb.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A petroleum ether extract was toxic to

black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

CUPHEA GLUTINOSA Cham. & Schlecht.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DECODON VERTICILLATUS (L.) Ell.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GINORIA AMERICANA Jacq.

Aqueous extracts of the roots and of the stems and leaves were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HEIMIA MYRTIFOLIA Cham. & Schlecht.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LAGERSTROEMIA SPECIOSA (L.) Pers.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LAWSONIA INERMIS L. Henna.

Acetone and water extracts of the leaves were ineffective against mosquito larvae.--Hartzell (89).

Aqueous extracts of the roots and of the stems and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LYTHRUM ALATUM Pursh.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LYTHRUM LANCEOLATUM Ell.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LYTHRUM SALICARIA L.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

MAGNOLIACEAE

ILLICIUM FLORIDANUM Ellis.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ILLICIUM VERUM Hook f. Star anise.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

Anisol and anethole, obtained from anise oil, did not increase the toxicity of a pyrethrum spray to house flies.--Kerr (114).

LIRIODENDRON TULIPIFERA L. Yellow poplar.

The wood is susceptible to termites.--Wolcott (225).

MAGNOLIA OBOVATA Thunb.

Water suspensions of the flowers, leaves, and stems were all ineffective against Drosophila hydei larvae, but a suspension of the leaves and stems was highly toxic to these larvae.--Yamaguchi and coworkers (233).

MAGNOLIA PORTORICENSIA Bello. Burro.

The wood is susceptible to termites.--Wolcott (225).

MAGNOLIA SPLENDENS Urban.

The wood is susceptible to termites.--Wolcott (225).

MICHELIA CHAMPACA L.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the stem bark was nontoxic to all these insects.--Heal and coworkers (93).

TALAUMA MEXICANA G. Don.

An aqueous extract of the stems and bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the stem bark was nontoxic to all these insects.--Heal and coworkers (93).

MALACEAE

ERIOBOTRYA JAPONICA (Thunb.) Lindl.

A water suspension of the leaves and stems was nontoxic to Drosophila hydei larvae, but a suspension of the flowers was highly toxic to these larvae.--Yamaguchi and coworkers (233).

MALPIGHIACEAE

BANISTERIA LEONA Cav.

An aqueous extract of the branches was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts of the branches and leaves were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

BANISTERIOPSIS CAAPI (Spruce) Morton.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BANISTERIOPSIS INEBRIANS Morton.

Aqueous extracts of the branches and leaves and of the stems were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BRYSONIMA CRASSIFOLIA (L.) H. B. K.
Synonym: B. cumingana Juss.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the stems was nontoxic to German and American cockroaches, and an aqueous extract of the bark was nontoxic to these and to milkweed bugs. An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

BRYSONIMA SPICATA (Cav.) DC.

The wood is very resistant to termites.--Wolcott (225).

BRYSONIMA sp.

An aqueous extract of the branches was nontoxic to German and American cockroaches.--Heal and coworkers (93).

GALPHIMIA BRASILIENSIS (L.) Juss.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GALPHIMIA GLAUCA Cav.

An aqueous extract of the branches and leaves was toxic to German cockroaches and slightly toxic to American cockroaches. An aqueous extract of the branches and flowers was nontoxic to both species of insects.--Heal and coworkers (93).

HETEROPTERIS LAURIFOLIA (L.) Juss.

An aqueous extract of the branches and fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HETEROPTERIS PLATYPTERA var MARTINICENSIS (Niedenzu) Macbr.

An aqueous extract of the roots was slightly toxic to American cockroache

and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HETEROPTERIS UMBELLATA St. Hil.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HIPTAGE BENGHALENSIS (L.) Kurz.

Aqueous extracts of the stem bark, the flowers, and the fruits were all very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Aqueous extracts of the stems and leaves and of the branchlets and leaves were nontoxic to all these insects. An alcohol extract of the flowers was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Alcohol and petroleum ether extracts of the fruits gave the same results, while a chloroform extract of the fruits was nontoxic to all these insects.--Heal and coworkers (93).

MALPIGHIA GLABRA L.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

MALPIGHIA PUNICIFOLIA L.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the stems and leaves was slightly toxic to American cockroaches only.--Heal and coworkers (93).

MASCAGNIA LEUCANTHELE Griseb.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the roots was nontoxic to all these insects.--Heal and coworkers (93).

TRAPTERIS ACUTIFOLIA Cav.

Some of the plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

MALVACEAE

ABUTILON INDICUM (L. Sweet).

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ABUTILON THEOPHRASTI Gaertn.

An aqueous extract of the tops was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was toxic to American cockroaches only, and an extract of the fruits and seeds was only slightly toxic to American cockroaches and nontoxic to the other insects tested. Alcohol and petroleum ether extracts of the tops were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. A chloroform extract of the tops was nontoxic to all these insects.--Heal and coworkers (93).

ALTHAEA OFFICINALIS L. Althea.

Acetone and water extracts of the roots were ineffective against mosquito larvae.--Hartzell (89).

CALLIRHOE ALCEOIDES (Michx.) A. Gray.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was slightly toxic to American cockroaches only.--Heal and coworkers (93).

CALLIRHOE DIGITATA Nutt.

An aqueous extract of the above-ground portion was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CATOSTEMMA COMMUNE Sandw. Baromalli.

The wood is very susceptible to termites.--Wolcott (225).

GOSSYPIUM HERBACEUM L.

An aqueous extract of an unidentified portion of the plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GOSSYPIUM HIRSUTUM L. Cotton.

Crude cottonseed oil was equal to, or superior to, petroleum oil against oyster-shell scale, Mexican mealybugs, and willow scurfy scale. Refined cottonseed oil was less effective.--Cressman and Dawsey (51).

Cottonseed oil was not very promising against San José scale.--Viel (216).

Cottonseed oil emulsified with soap and soda ash was especially effective against aphids found on citrus trees.--Stepanek and Prien (201).

HIBISCUS ABELMOSCHUS L. Ambrette.

An acetone extract of the seed was toxic to mosquito larvae.--Hartzell (90)

An aqueous extract of the upper parts and fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. A petroleum ether extract of the seeds was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts of the seeds were nontoxic to all these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

KOSTELETZKYA VIRGINICA (L.) Presl.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the whole plant was slightly toxic to American cockroaches only.--Heal and coworkers (93).

MALVASTRUM RUSBYI Britton.

An aqueous extract of the tips and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MONTEZUMA SPECIOSISSIMA DC.

The wood is very resistant to termites.--Wolcott (225).

NOTOTRICHE sp.

An aqueous extract of the roots, stems, and flowers was slightly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SIDA ACUTA Burm. f.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SIDA CORDIFOLIA L.

An aqueous extract of the tops, flowers, and fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the seeds was very toxic to American cockroaches and nontoxic to the other insects tested.--Heal and coworkers (93).

SPHAERALCEA COCCINEA (Nutt.) Rydb.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

THESPESIA POPULNEA (L.) Soland.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was nontoxic to all these insects.--Heal and coworkers (93).

MARANTACEAE

MARANTOCHLOA FLEXUOSA (Benth.) Hutch.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

THALIA GENICULATA L.

An aqueous extract of the tops was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MARCGRAVIACEAE

MARCGRAVIA sp.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MARTYNIACEAE

MARTYNIA LOUISIANICA Mill. Unicorn plant, ram's horn.

The powdered stems were toxic to melonworms but not to southern armyworms and southern beet webworms.--Bottger and Jacobson (36).

The powdered stems were nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the seeds and pods and of the stems were all nontoxic to house flies, but the combined extracts of the stems showed some toxicity to codling moth larvae.--Jacobson (108).

An aqueous extract of the whole plant with fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MELASTOMATACEAE

ISSOTIS ROTUNDIFOLIA Triana.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

OURIRIA MARSHALLII B. Davy & Sandw.

An aqueous extract of the stem bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BECKIA CRINITA Benth.

The powdered roots showed little toxicity to silkworm and Mexican bean beetle larvae and bean aphids.--Lee and Hansberry (129).

MELIACEAE

AZADIRACHTA INDICA (L.) Juss. Synonym: *Melia azadirachta*. Nim tree, neem tree.

Neem oil protects livestock from flies.--Perera (171).

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CARAPA GRANDIFLORA Sprague.

Aqueous extracts of the roots and of the stem bark were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CARAPA GUIANENSIS Aubl.

The powdered leaves, petioles, bark, and wood each showed little or no toxicity to several species of insects.--Plank (173).

The powdered seeds with petioles and the powdered roots each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs. The powdered leaves, petioles, bark, and wood each showed little or no toxicity to melonworm, fall armyworm, and diamondback moth larvae, *Diabrotica bivittata* and cotton stainer adults, and American cockroach nymphs.--Plank (174).

An aqueous extract of the fruits was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the bark was nontoxic to both species of cockroaches. Alcohol and petroleum ether extracts of the fruits were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes. A chloroform extract of the fruits was nontoxic to German cockroaches, milkweed bugs, and *Aedes* mosquito larvae.--Heal and coworkers (93).

CARAPA NICARAGUENSIS C. DC.

The wood is susceptible to termites.--Wolcott (226).

CARAPA PROCERA DC. Andiroba, crabwood.

The seed oil is reported to be an insecticide and an activator for rotenone. A sample of the oil from South America was neither a repellent nor a synergist with pyrethrins or rotenone.--Jacobson (108).

CEDRELA ODORATA L. Spanish cedar.

The wood is resistant to termites.--Wolcott (225).

An aqueous extract of the leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the seeds was toxic to German cockroaches, slightly toxic to American cockroaches, and nontoxic to milkweed bugs.--Heal and coworkers (93).

CEDRELA sp.

An aqueous extract of a sample of the bark was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An aqueous extract of a second sample of bark was nontoxic to all these insects.--Heal and coworkers (93).

EKEBERGIA RUEPELLIANA A. Rich.

Aqueous extracts of the branchlets and of the roots were nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the stem bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GUAREA RUSBYI (Britton) Rusby. Cocillana.

An acetone extract of the bark was ineffective against mosquito larvae.--Hartzell (90).

GUAREA TRICHILIOIDES L. Alligatorwood.

The wood is resistant to termites.--Wolcott (225).

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

GUAREA sp.

An aqueous extract of the stems and roots was toxic to German cockroaches and slightly toxic to American cockroaches.--Heal and coworkers (93).

KHAYA IVORENSIS. African mahogany.

The wood is very susceptible to termites.--Wolcott (225).

MELIA AZEDARACH L. Chinaberry, Indian lilac.

The plant is repellent to grasshoppers and locusts. The extract obtained by soaking 150 grams of fresh leaves or 50 grams of dried leaves (or fruit, green or dry) in one liter of water for 24 hours was repellent but nontoxic to Acrididae.--Anonymous (17).

The powdered bark and powdered stems had no effect on bean aphids.--Chiu and coworkers (48).

Fresh infusions of the fruits and leaves repelled adults and nymphs of the grasshopper Schistocera cancellata when sprayed on coffee and cabbage plants under laboratory conditions.--LePage and coworkers (131).

The wood is very susceptible to termites.--Wolcott (225).

The leaves and fruit are used as insecticides in the Philippines.--Quisumbing (179).

Pyrax dusts of extracts of the bark and of the leaves, and also of crystals isolated from the leaves, were all nontoxic to armyworms, pea aphids, celery leaf tiers, and two-spotted spider mites.--Bottger and Jacobson (36).

The powdered fruit was slightly toxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extracts of the fruit were nontoxic to house flies and only slightly toxic to codling moth larvae.--Jacobson (108).

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches. An aqueous extract of a sample of the fruit was toxic to American cockroaches only while an extract of a second sample of fruits was toxic to German cockroache

only. Alcohol and petroleum ether extracts of the bark were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A petroleum ether extract of the second fruit sample was toxic to black carpet beetle larvae only, and an alcohol extract of this sample was nontoxic to all these insects.--Heal and coworkers (93).

PTAEROXYLON UTILE Eckl. & Zeyh.

Aqueous extracts of the branchlets and leaves and of the roots were both nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SWIETENIA MACROPHYLLA King. Honduras mahogany.

The heartwood showed little resistance :o termites.--Wolcott (225).

An aqueous extract of the seeds was slightly toxic to American cockroaches ınd nontoxic to German cockroaches and nilkweed bugs.--Heal and coworkers (93).

;WIETENIA MAHAGONI Jacq. West Indian mahogany.

The heartwood, but not the sapwood, is ery resistant to termites.--Wolcott (225).

An aqueous extract of the seeds was oxic to American cockroaches when inected into the blood stream, but German ockroaches and milkweed bugs were unffected after immersion in the extract.--eal and coworkers (93).

RICHILIA GUIANENSIS Klotzsch.

An aqueous extract of the stem bark was ontoxic to German and American cockaches and milkweed bugs.--Heal and workers (93).

RICHILIA HAVANENSIS Jacq.

An aqueous extract of the stem bark s toxic to American cockroaches when ected into the blood stream, but German ckroaches and milkweed bugs were unected after immersion in the extract.--al and coworkers (93).

ICHILIA HIRTA L.

An aqueous extract of the branchlets and ves was toxic to American cockroaches, but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

WALSURA PISCIDIA Roxb.

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

MELIANTHACEAE

BERSAMA PAULLINIOIDES Baker.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was toxic to black carpet beetle and webbing clothes moth larvae only. A chloroform extract of the leaves was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

MELIANTHUS MINOR L.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MENISPERMACEAE

ABUTA OBOVATA Diels.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

ABUTA RUFESCENS Aubl.

An aqueous extract of the roots and stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ABUTA sp.

An aqueous extract of the fruits was nontoxic to German and American cock-

roaches and milkweed bugs.--Heal and coworkers (93).

ANAMIRTA COCCULUS (L.) Wight & Arn. Synonym: Cocculus indicus. Fishberry.

Picrotoxin, isolated from fishberries, showed little or no toxicity to green peach aphids, adults and fourth instar larvae of the Mexican bean beetle, adult American cockroaches, and house flies. It showed some toxicity to second instar larvae of the Mexican bean beetle.--McGovran and coworkers (144).

Acetone and water extracts of the berries were ineffective against mosquito larvae.--Hartzell (89).

The plant is used as an insecticide in the Philippines.--Quisumbing (179).

The powdered berries and petroleum ether and alcohol extracts thereof were all nontoxic to armyworms, pea aphids, celery leaf tiers, and two-spotted spider mites.--Bottger and Jacobson (36).

The powdered berries were nontoxic to European corn borer larvae. Petroleum ether, ethyl ether, chloroform, and alcohol extractives of the berries were all nontoxic to house flies. The petroleum ether extractive was ineffective against chiggers, lone star ticks, dog and cat fleas, mosquito larvae, corn borers, body lice, and as a mosquito repellent, but it was somewhat effective as a body louse ovicide.--Jacobson (108).

An aqueous extract of the seeds and stems was very toxic to German and American cockroaches. Alcohol, petroleum ether, and chloroform extracts of the seeds were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ANOMOSPERMUM SCHOMBURGKII Miers.

Alcohol, petroleum ether, and chloroform extracts of the fruits were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

BURASAIA MADAGASCARIENSIS DC.

An aqueous extract of the wood chips was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CALYCOCARPUM LYONII (Pursh.) A. Gray.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CISSAMPLOS PAREIRA L.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

COCCULUS CAROLINUS (L.) DC. Synonym: Epibaterium carolinum. Carolina moonseed, coral beads.

The powdered leaves, stems, and roots were all nontoxic to melonworms, southern armyworms, and southern beet webworms.--Bottger and Jacobson (36).

The powdered leaves, stems, and roots were all nontoxic to European corn borer larvae. The powdered fruits were nontoxic to body lice. Combined petroleum ether, ethyl ether, chloroform, and alcohol extracts of the leaves, the stems, and the roots were all nontoxic to house flies but somewhat toxic to codling moth larvae.--Jacobson (108).

An aqueous extract of the branches and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An aqueous extract of the fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. A petroleum ether extract of the stems and leaves was toxic to milkweed bugs and black carpet beetle larvae, but not to German cockroaches and larvae of the webbing clothes moth and Anopheles mosquito. A chloroform extract of the stems and leaves was toxic to black carpet beetle larvae only, while an alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

COCCULUS TRILOBUS DC.

Water suspensions of the leaves and roots and of the roots alone were highly toxic to Drosophila hydei larvae. A suspension of the seeds was less toxic to the larvae.--Yamaguchi and coworkers (233).

JATEORRHIZA PALMATA (Lam.) Miers. Colombo.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

MENISPERMUM CANADENSE L.

An aqueous extract of root fragments was nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the fruits was toxic to American cockroaches only.--Heal and coworkers (93).

PACHYGONE OVATA Miers.

An aqueous extract of the stems, leaves, and roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

STEPHANIA HERNANDIFOLIA Walp.

Aqueous extracts of the leaves and of the stems were toxic to German cockroaches but not to American cockroaches.--Heal and coworkers (93).

TRICLISIA SACLEUXII Diels.

Aqueous extracts of the roots and of the fruits were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MIMOSACEAE

ALBIZZIA FALCATA (L.) Baker.

ALBIZZIA JULIBRISSIN Durazy.

The plants were nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

ALBIZZIA LEBBECK (L.) Benth.

Some of the plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

ALBIZZIA PROCERA (Roxb.) Benth. White siris.

The wood is resistant to termites.--Wolcott (225).

DESMANTHUS VIRGATUS (L.) Willd. Synonym: Acuan virgatum.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

LYSILOMA LATISILIQUA (L.) Benth. Tabernau.

The wood is resistant to termites.--Wolcott (226).

MONIMIACEAE

ATHEROSPERMA MOSCHATUM Labill. Sassafras.

The essential oil was repellent to Aedes mosquitoes but not to bush flies, Musca vetustissima.--McCulloch and Waterhouse (142).

The essential oil was moderately effective in synergizing pyrethrins in tests against house flies.--Kerr (114).

DORYPHORA SASSAFRAS Endl. Sassafras.

The essential oil was repellent to Aedes mosquitoes but not to bush flies.--McCulloch and Waterhouse (142).

The essential oil was a very effective synergist with pyrethrins against house flies. Of the constituents of the oil, safrole, alpha-pinene, and eugenol showed weak synergism. Unidentified sesquiterpenes probably account for the action of the oil.--Kerr (114).

LAURELIA SEMPERVIRENS (Ruiz & Pavon) Tul.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PEUMUS BOLDUS Mol. Synonym: Boldoa fragrans. Boldo.

An acetone extract of the leaves was ineffective against mosquito larvae.--Hartzell (90).

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SIPARUNA GUIANENSIS Aubl.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the stem bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SIPARUNA NICARAGUENSIS Hemsl.

An aqueous extract of the leaves was toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

SIPARUNA RIPARIA (Tul.) A. DC.

An aqueous extract of the leaves was slightly toxic to American cockroaches.--Heal and coworkers (93).

TAMBOURISSA QUADRIFIDA Sonner.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was nontoxic to all these insects.--Heal and coworkers (93).

MORACEAE

ARTOCARPUS COMMUNIS Forst. Synonym: A. incisa. Breadfruit tree.

The wood is very susceptible to termites.--Wolcott (225).

An aqueous extract of the branchlets and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Petroleum ether and chloroform extracts of the branchlets and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

ARTOCARPUS INTEGRA (Thunb.) Merr.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts were nontoxic to all these insects, as well as to Aedes mosquito larvae.--Heal and coworkers (93).

BROSIMOPSIS AMPLIFOLIA Ducke.

An aqueous extract of the bark was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. A petroleum ether extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts were nontoxic to all these insects as well as to Aedes mosquito larvae.--Heal and coworkers (93).

BROSIMOPSIS sp.

An aqueous extract of the bark was toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

BROSIMUM PARAENSE Huber. Cardinal-wood.

The wood is very resistant to termites.--Wolcott (225).

CARDIOGYNE AFRICANA Bureau.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CECROPIA ADENOPUS Mart.

An aqueous extract of the leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CECROPIA MEXICANA Hemsl.

The ashes of this plant are used as a stomach poison for cottonleaf armyworms in El Salvador.--Wellman and van Severen (221).

CECROPIA PALMATA Willd.

Aqueous extracts of the bark showed some toxicity to German and American cockroaches.--Heal and coworkers (93).

CECROPIA PELTATA L.

Aqueous extracts of the leaves, the bark, and the roots were all toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CECROPIA sp. Imbauba.

A 20-percent talc dust of the combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the leaves was nontoxic to cabbage loopers, melonworms, and southern armyworms.--Bottger and Jacobson (36).

It is claimed that food wrapped in the leaves of this plant by the natives of Brazil is not attacked by insects. The powdered leaves showed some repellency and toxicity to ants and German cockroaches. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the

leaves were nontoxic to house flies, codling moths, clothes moth larvae, and European corn borer larvae.--Jacobson (108).

CHLOROPHORA EXCELSA (Welw.) Benth. & Hook.

An aqueous extract of the leaves was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Aqueous extracts of the roots and of the stem wood were slightly toxic to American cockroaches only.--Heal and coworkers (93).

CHLOROPHORA TINCTORIA (L.) Gaud. Dyer's mulberry.

This tree is practically immune from attack by the West Indian drywood termite.--Wolcott (224).

An aqueous extract of the bark was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DORSTENIA BRASILIENSIS Lam.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DORSTENIA CONTRAJERUA L.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

FICUS ELASTICA Roxb. Rubber plant.

The wood is very susceptible to termites.--Wolcott (225).

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

FICUS LAEVIGATA Vahl. Wild fig.

FICUS NITIDA Blume.

These woods are very susceptible to termites.--Wolcott (225).

FICUS VOGELII Miq.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HUMULUS LUPULUS L. Hop.

Acetone and water extracts of the whole plant were ineffective against mosquito larvae.--Hartzell (89).

The powdered leaves were toxic to southern armyworms and melonworms but not to striped blister beetles.--Bottger and Jacobson (36).

The powdered leaves were ineffective against European corn borer larvae and Mexican bean beetles. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the leaves were nontoxic to house flies and codling moth larvae.--Jacobson (108).

MACLURA POMIFERA (Raf.) Schneid. Osage orange.

The roots, wood, and bark of this plant repel insects.--Aries (28).

This tree is practically immune from attack by the West Indian drywood termite.--Wolcott (224).

A yellow pigment isolated from the root bark possessed some insecticidal activity, but did not compare with rotenone.--Wolfrom and coworkers (229).

An aqueous extract of the wood was nontoxic to mosquito larvae.--Jacobson (108).

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

MAILLARDIA BORBONICA Ducke.

Aqueous extracts of the branches and leaves and of the roots were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol and petroleum ether extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* mosquito. A chloroform extract of the roots was nontoxic to all these insects. An aqueous extract of the stem bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MYRIANTHUS ARBORUS Beauv.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TROPHIS RACEMOSA (L.) Urban.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MORINGACEAE

MORINGA OLEIFERA Lam.

Aqueous extracts of the seeds and of the stem bark were nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to the other two species of insects tested.--Heal and coworkers (93).

MUSACEAE

HELICONIA BIHAI L. Plantain, oja de fopocho.

It has been claimed that food wrapped in the leaves of this plant is not attacked by insects. In laboratory tests, the leaves did not protect sugar from ants or flies and they were only slightly repellent to cockroaches. A petroleum ether extractive and the combined ethyl ether, chloroform, and alcohol extractives of the leaves showed no repellency to ants, cockroaches, Aedes and Anopheles mosquitoes, and confused flour beetles. The combined extractives were neither repellent nor toxic to black carpet beetle larvae.--Jacobson (108).

MUSA SAPIENTUM var. PARADISAICA L. Banana.

Banana leaves showed no repellency to ants and only slight repellency to German cockroaches.--Jacobson (108).

MYOPORACEAE

BONTIA DAPHNOIDES.

Some of the plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the stems and leaves showed little or no toxicity to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EREMOPHILA MACULATA F. Muell.

An aqueous extract of the stem bark and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

EREMOPHILA MITCHELLI Benth. Sandalbox.

The essential oil did not repel Aedes mosquitoes or Australian sheep blowflies.--McCulloch and Waterhouse (142).

The essential oil did not repel Australian sheep blowflies.--Waterhouse (220).

The essential oil obtained from the wood was an effective synergist with pyrethrins against house flies, although nontoxic of itself.--Kerr (114).

MYOPORUM DESERTI A. Cunn.

Aqueous extracts of the branches and leaves and of the stem bark were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MYRICACEAE

COMPTONIA PEREGRINA (L.) Coult. Synonym: Myrica asplenifolia. Sweet fern.

Acetone and water extracts of the leaves and stems were ineffective against mosquito larvae.--Hartzell (89).

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

MYRICA CERIFERA L.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches. An alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito.--Heal and coworkers (93).

MYRICA GALE L.

An aqueous extract of the branchlets and leaves was very toxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MYRICA SALICIFOLIA Hochst.

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MYRISTICACEAE

DIALYANTHERA OTOBA (H. B. K.) Warb.

Aqueous extracts of the fruits were toxic to German and American cockroaches but nontoxic to milkweed bugs. Aqueous extracts of the fat were toxic to all these insects. A petroleum ether extract of the fruits was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and webbing clothes moth larvae.--Heal and coworkers (93).

MYRISTICA FRAGRANS Houtt. Nutmeg.

An aqueous extract of nutmegs was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

Myristicin, obtained from nutmeg oil, markedly increased the toxicity of a standard pyrethrum spray to house flies.--Kerr (114).

The essential oil of the leaves gave about 10-percent control of Agathi (Sesbania grandiflora) aphids, but afforded little or no control of other insects.--Khan and Krishnaswamy (115).

MYRSINACEAE

AEGICERAS CORNICULATUM (L.) Blanco.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

ARDISIA CRISPA (Thunb.) A. DC. var. DIELSII.

The powdered root showed considerable toxicity to Mexican bean beetle larvae, but it had no effect on bean aphids. Alcohol and chloroform extracts were ineffective against silkworm larvae and bean aphids.--Lee and Hansberry (129).

ARDISIA ESCALLONIOIDES Schlecht. & Cham.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the stems was nontoxic to all these insects. A petroleum ether extract of the stems was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and webbing clothes moth larvae. Alcohol and chloroform extracts of the stems were nontoxic to all these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

ARDISIA GUADALUPENSIS Duchass.

Aqueous extracts of the bark and of the leaves were nontoxic to German and American cockroaches.--Heal and coworkers (93).

ARDISIA GUIANENSIS (Aubl.) Mez.

An aqueous extract of the roots was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ARDISIA HUMILIS Vahl.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ARDISIA OBOVATA Blume.

Aqueous extracts of the roots and of the stem bark were toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ARDISIA PICARDAE Urban.

Aqueous extracts of the roots and of the stem bark were very toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An alcohol extract of the stem bark was toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and Anopheles mosquito larvae. Petroleum ether and chloroform extracts were nontoxic to all these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

ARDISIA POPAYANENSIS Mez.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ARDISIA REVOLUTA H. B. K.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BADULA BORBONICA A. DC.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CONOMORPHA MAGNOLIIFOLIA Mez.

An aqueous extract of the bark was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

CONOMORPHA PERUVIANA A. DC. var. ROSTRATA.

Aqueous extracts of the bark and of the roots were toxic to American cockroaches but not to German cockroaches and milkweed bugs. Alcohol extracts of the bark and of the roots were both toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and Aedes and Anopheles mosquito larvae. Petroleum ether extracts were toxic to black carpet beetle larvae only. A chloroform extract of the bark was toxic to webbing clothes moth larvae only, while a chloroform extract of the roots was toxic to black carpet beetle larvae only.--Heal and coworkers (93).

CONOMORPHA sp.

An aqueous extract of the roots was very toxic to American cockroaches, but nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the bark was slightly toxic to American cockroaches only. Petroleum ether and chloroform extracts of the bark were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes mosquito. An alcohol extract of the bark was nontoxic to all these insects and to Anopheles mosquito larvae. An alcohol extract of the roots was toxic to larvae of the webbing clothes moth and black carpet beetle only. Petroleum ether and chloroform extracts of the roots were toxic to black carpet beetle larvae only.--Heal and coworkers (93).

CYBIANTHUS BROWNII Gleason.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract of the roots was nontoxic to German cockroaches, milkweed bugs, and Aedes mosquito larvae.--Heal and coworkers (93).

CYBIANTHUS sp.

An aqueous extract of the bark was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

EMBELIA KILIMANDSCHARICA Gilg.

An aqueous extract of the stem bark was very toxic to American cockroaches when injected into the blood stream but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract of the stem bark was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Petroleum ether and chloroform extracts of the fruits were toxic to black carpet beetle larvae only, while alcohol and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

GEISSANTHUS ANDINUS Mez.

An aqueous extract of the bark was toxic to American cockroaches when injected into

the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

MAESA CHISIA D. Don.

Aqueous extracts of the bark and of the roots were both toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. An aqueous extract of the branchlets and leaves was nontoxic to all these insects.--Heal and coworkers (93).

MAESA DENTICULATA Mez. Patipat.

An acetone extract of the bark was ineffective against mosquito larvae.--Jacobson (108).

MAESA INDICA Wall.

Aqueous extracts of the stems and leaves, and of the branchlets, leaves, and bark were very toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs. A petroleum ether extract of the branchlets, leaves, and bark was toxic to larvae of the black carpet beetle and webbing clothes moth, but not to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae. Alcohol and chloroform extracts were toxic to black carpet beetle larvae only. Petroleum ether, alcohol, and chloroform extracts of the branches and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

MAESA RUFESCENS A. DC.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An aqueous extract of the stem bark was nontoxic to all these insects. A petroleum ether extract of the roots was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. A petroleum ether extract of the stem bark was toxic to webbing clothes moth and black carpet beetle larvae only.--Heal and coworkers (93).

MYRSINE AFRICANA L.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MYRSINE CANARIENSIS Spreng.

Aqueous extracts of the branchlets and leaves and of the roots were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol, petroleum ether, and chloroform extracts of the roots were nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

PARATHESIS SERRULATA (Sw.) Mez.

An aqueous extract of the stems and roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RAPANEA FERRUGINEA (Ruiz & Pavon) Mez.

Aqueous extracts of the roots and of the bark were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RAPANEA LAETIVIRENS Mez.

An aqueous extract of the bark was highly toxic to American cockroaches and milkweed bugs, but nontoxic to German cockroaches. Alcohol, petroleum ether, and chloroform extracts of the bark were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

RAPANEA LORENTZIANA Mez.

An aqueous extract of the stem bark was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and chloroform extracts were toxic to black carpet beetle larvae, but not to

German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A petroleum ether extract was nontoxic to all these insects.--Heal and coworkers (93).

RAPANEA UMBELLATA (Mart.) Mez.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and chloroform extracts of the roots were nontoxic to all these insects.--Heal and coworkers (93).

RAPANEA sp.

Aqueous extracts of the roots and of the stems and leaves were both toxic to American cockroaches, but not to German cockroaches and milkweed bugs. An aqueous extract of the bark was slightly toxic to American cockroaches only. Alcohol and chloroform extracts of the bark were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. A petroleum ether extract of the bark was nontoxic to all these insects.--Heal and coworkers (93).

STYLOGYNE SCHOMBURGKIANA (A. DC.) Mez.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

WALLENIA LAURIFOLIA Sw.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

WEIGELTIA SURINAMENSIS (Spreng f.) Mez.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MYRTACEAE

AMOMIS GRISEA (Kiaersk.) Limoncillo, pimienta.

The wood is resistant to termites.--Wolcott (225).

BACKHOUSIA MYRTIFOLIA Hook. & Harv.

The essential oil was both repellent and toxic to Aedes and Anopheles mosquitoes, but it did not repel bush flies. The active constituent is probably elemicin.--McCulloch and Waterhouse (142).

The essential oil was a very effective synergist with pyrethrins against house flies. Used alone, it paralyzed flies slowly. Elemicin, present in the oil to the extent of 75-80 percent, was as effective a synergist as the oil itself.--Kerr (114).

BLEPHAROCALYX GIGANTEUS Lillo.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the branches and leaves was nontoxic to all these insects.--Heal and coworkers (93).

EUCALYPTUS AUSTRALIANA R. T. Baker & H. G. Sm.

The leaf essential oil did not synergize pyrethrins in tests against house flies.--Kerr (114).

EUCALYPTUS BOTRYOIDES Sm.

The powdered leaves killed Aedes punctor adults in 20 minutes.--Olenev (163).

EUCALYPTUS CITRIODORA Hook.

The wood is very susceptible to termites.--Wolcott (225).

The essential oil did not repel the Australian sheep blowfly but was attractive to it.--Waterhouse (220).

Neither the leaf essential oil nor citronellal obtained from it synergized pyrethrins in tests against house flies.--Kerr (114).

EUCALYPTUS DIVES Schauer.

The essential oil did not repel Aedes mosquitoes or Australian sheep blowflies.--McCulloch and Waterhouse (142).

The residual oil from steam distillation of the leaves did not synergize pyrethrins in tests against house flies.--Kerr (114).

The oil is used in sheep fly preparations.--Penfold and Morrison (167).

EUCALYPTUS DUMOSA A. Cunn.

The essential oil was repellent to Aedes mosquitoes but not to Australian sheep blowflies.--McCulloch and Waterhouse (142).

EUCALYPTUS GLOBULUS Labill.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches. Alcohol and petroleum ether extracts of the leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

EUCALYPTUS PANICULATA Sm.

The powdered leaves killed Aedes punctor adults in 20 minutes.--Olenev (163).

EUCALYPTUS PHELLANDRA.

The essential oil did not repel Aedes mosquitoes or Australian sheep blowflies.--McCulloch and Waterhouse (142).

The essential oil did not repel Australian sheep blowflies.--Waterhouse (220).

UCALYPTUS POLYBRACTEA R. T. Baker.

The essential oil did not repel Aedes osquitoes or Australian sheep blowflies.--cCulloch and Waterhouse (142).

The leaf essential oil did not synergize rethrins in tests against house flies.--err (114).

JCALYPTUS SIDEROXYLON A. Cunn.

The residual oil from the steam distillan of the leaves did not synergize pyrethns in tests against house flies.--Kerr 4).

JCALYPTUS sp.

Eucalyptus oil is a common insecticide Venezuela.--Higbee (94).

Eucalyptus oil (10 percent in liquid paraffin) did not repel the Australian sheep blowfly.--Mackerras and Mackerras (134).

The essential oil of an unidentified species was repellent to Aedes mosquitoes but not to Australian sheep blowflies. Phellandrene, found in some species of Eucalyptus, did not repel Aedes mosquitoes.--McCulloch and Waterhouse (142).

The powdered leaves, bark, wood, and roots each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

Eudesamin, which occurs in the kino from certain species of Eucalyptus, synergized pyrethrins in tests against house flies, but its activity was poor in comparison with that of sesamin.--Kerr (114).

EUGENIA ATROPUNCTATA Steud.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

EUGENIA CARYOPHYLLATA Thunb. Synonym: E. aromatica. Clove tree.

An aqueous extract of the cloves was toxic to German cockroaches but not to American cockroaches.--Heal and coworkers (93).

An acetone extract of the flower buds was toxic to mosquito larvae, but a water extract was nontoxic.--Hartzell (89).

EUGENIA HAITIENSIS Krug. & Urban.

A kerosene solution of the leaf essential oil is used by the natives in Haiti as an insecticide against flies, mosquitoes, and bedbugs. When tested without dilution, the oil gave complete knockdown and high mortality of house flies and adult mosquitoes, but a 50-percent solution in refined kerosene caused low mortality although there was still complete initial knockdown. The active constituent was found to be 1,8-cineol (eucalyptol), which showed toxicity of the same order as the original oil.--Jacobson and Haller (110).

The leaf essential oil was only slightly effective against codling moth larvae and it was ineffective against clothes moth larvae, variegated cutworms, and European corn borer larvae.--Jacobson (108).

EUGENIA JAMBOS L. Rose apple.

The wood is very susceptible to termites.--Wolcott (225).

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EUGENIA MALACCENSIS L.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EUGENIA sp.

Cineol, present in several species of Eugenia, did not repel Aedes mosquitoes.--McCulloch and Waterhouse (142).

An aqueous extract of the roots of an unidentified species was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. A chloroform extract of the roots was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle and webbing clothes moth.--Heal and coworkers (93).

LEPTOSPERMUM SCOPARIUM Forst.

Leptospermone, occurring in the essential oil, markedly increased the toxicity of a standard pyrethrum spray to house flies.--Kerr (114).

MELALEUCA ALTERNIFOLIA (Maiden & Betche) Cheel.

The essential oil did not repel Aedes mosquitoes.--McCulloch and Waterhouse (142).

MELALEUCA BRACTEATA F. Muell.

The essential oil was repellent to Aedes mosquitoes.--McCulloch and Waterhouse (142).

The essential oil was a very effective synergist with pyrethrins against house flies. It exhibited no knockdown or mortality of its own. Methyl eugenol, extracted from the oil, was an active synergist but less so than the oil itself. Phellandrene had no synergistic action.--Kerr (114).

MELALEUCA ERICIFOLIA Sm.

The essential oil repelled neither Aedes mosquitoes nor Australian sheep blowflies.--McCulloch and Waterhouse (142).

MELALEUCA LEUCADENDRON L.

The essential oil did not repel Aedes and Anopheles mosquitoes.--McCulloch and Waterhouse (142).

The essential oil did not synergize pyrethrins in tests against house flies.--Kerr (114).

MELALEUCA LINARIIFOLIA Sm.

The essential oil repelled neither Aedes mosquitoes nor Australian sheep blowflies.--McCulloch and Waterhouse (142).

The essential oil did not synergize pyrethrins in tests against house flies.--Kerr (114).

MELALEUCA UNCINATA R. Br.

The essential oil did not repel Aedes mosquitoes.--McCulloch and Waterhouse (142).

The essential oil did not synergize pyrethrins in tests against house flies.--Kerr (114).

MYRCIA RUFIDULA Schlecht.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

MYRCIA sp.

An alcohol extract of the stems was nontoxic to German cockroaches, milkweed bugs, and Aedes and Anopheles mosquito larvae.--Heal and coworkers (93).

MYRTUS COMMUNIS L.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PIMENTA OFFICINALIS Lindl. Synonyms P. pimenta, P. vulgaris. Allspice.

Acetone and water extracts of the dried unripe berries were ineffective against mosquito larvae.--Hartzell (89).

PIMENTA RACEMOSA (Mill.) J. W. Moore. Synonym: *P. acris*. Bay rum.

Oil of bay rum is a common insecticide in Venezuela.--Higbee (94).

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PIMENTA sp.

A mixture of 90 parts geraniol and 10 parts *Pimenta* leaf oil, or 90 parts anethole and 10 parts leaf oil, was as attractive to Japanese beetles as a standard bait composed of 90 parts geraniol and 10 parts eugenol.--Fleming and Chisholm (62).

PSIDIUM GUAYAVA L. Guayava.

The wood is very susceptible to termites.--Wolcott (225).

SYNCARPIA LAURIFOLIA Tenore. Australian turpentine.

The wood is resistant to termites.--Wolcott (226).

NYCTAGINACEAE

ABRONIA FRAGRANS Nutt.

An aqueous extract of the roots was non-
oxic to German and American cockroaches
nd milkweed bugs.--Heal and coworkers
93).

BRONIA TURBINATA Torr.

An aqueous extract of the roots was toxic
American cockroaches when injected into
e blood stream, but German cockroaches
d milkweed bugs were unaffected after
mersion in the extract. An aqueous ex-
act of the above-ground portions was
ntoxic to all these insects.--Heal and
workers (93).

LIONIA INCARNATA L.

An aqueous extract of the whole plant was
ry toxic to American cockroaches when
ected into the blood stream, but German
kroaches and milkweed bugs were unaf-
ted after immersion in the extract. Pe-
leum ether and chloroform extracts were
ic to webbing clothes moth and black
pet beetle larvae, but not to German
kroaches, milkweed bugs, and confused flour beetles. An alcohol extract was toxic to black carpet beetle larvae only.--Heal and coworkers (93).

ANULOCAULIS ERIOSOLENUS (A. Gray) Standl.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ANULOCAULIS LEIOSOLENUS (Torr.) Standl.

An aqueous extract of the leaves was highly toxic to German and American cockroaches. Petroleum ether and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* mosquito. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

BOERHAAVIA COCCINEA Mill.

BOERHAAVIA ERECTA L.

Aqueous extracts of the whole plant of each species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COMMICARPUS SCANDENS (L.) Standl.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

MIRABILIS JALAPA L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

OXYBAPHUS LINEARIS (Pursh) Robinson. Synonym: *Allionia linearis*.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TORRUBIA DOMINGENSIS (Heimerl.) Standl.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TORRUBIA LONGIFOLIA (Heimerl.) Britton.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

NYMPHAEACEAE

BRASENIA SCHREBERI Gmel.

CABOMBA CAROLINIANA A. Gray.

Aqueous extracts of the whole plant were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

NELUMBO LUTEA (Willd.) Pers.

An aqueous extract of the stems and roots was slightly toxic to American cockroaches and milkweed bugs.--Heal and coworkers (93).

NUPHAR ADVEN (Ait.) Ait. f.

An aqueous extract of the roots and underground stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

NYMPHAEA ODORATA Ait. Synonym: Castalia odorata.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

NYMPHAEA TUBEROSA Paine. Synonym: Castalia tuberosa.

An aqueous extract of the whole plant was toxic to German cockroaches, but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

OCHNACEAE

BRACKENRIDGEA ZANGUEBARICA Oliv.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CESPEDESIA AMAZONICA Huber.

An aqueous extract of the stem bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

WALLACEA INSIGNIS Spruce.

The powdered bark was nontoxic to Mexican bean beetle larvae and only slightly toxic to silkworm larvae.--Hansberry and Clausen (86).

OCTOKNEMATACEAE

OCTOKNEMA BOREALIS Hutch. & Dalz.

Aqueous extracts of the branches and leaves and of the roots were each nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

OLACACEAE

MINQUARTIS GUIANENSIS Aubl.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SCHOEPFIA SCHREBERI J. F. Gmel.

Aqueous extracts of the branches and leaves, and of the roots were both toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

XIMENIA AMERICANA L.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches. An aqueous extract of the fruits was nontoxic to these insects and to milkweed bugs.--Heal and coworkers (93).

OLEACEAE

FORESTIERA NEOMEXICANA A. Gray.

An aqueous extract of the fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

FRAXINUS AMERICANA L. Fraxinus.

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

FRAXINUS NIGRA Marsh. Black ash.

An acetone extract of the bark was ineffective against mosquito larvae.--Hartzell (90).

FRAXINUS QUADRANGULATA Michx.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

JASMINUM MAURITIANUM Boj.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LIGUSTRUM OBTUSIFOLIUM Sieb. & Zucc.

A water suspension of the leaves and stems was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

LINOCIERA DOMINGENSIS (Lam.) Knobl.

The wood is suceptible to termites.--Wolcott (225).

OLEA CUNNINGHAMII Hook f.

Isoölivil, obtained from the resin and wood of this plant, did not synergize pyrethrins in tests against house flies.--Kerr (114).

OSMANTHUS AMERICANA (L.) Benth. & Hook.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TEGANTHUS WELWITSCHII Knobl.

An aqueous extract of the stem bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SYRINGA OBLATA Lindl.

Alcohol, chloroform, and petroleum ether extracts of the plant were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

SYRINGA VULGARIS L.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

ONAGRACEAE

CIRCAEA LATIFOLIA Hill.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GAURA COCCINEA Nutt.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GAURA SINUATA Nutt.

An aqueous extract of the stems, leaves, and roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

JUSSIAEA CALIFORNICA Jepson.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LUDWIGIA ALTERNIFOLIA L.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LUDWIGIA PALUSTRIS (L.) Ell.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

OENOTHERA BIENNIS L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ZAUSCHNERIA CALIFORNICA Presl.

An aqueous extract of the tops and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ORCHIDACEAE

BLETIA PATULA Hook.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BLETIA PURPUREA (Lam.) DC.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

DENDROBIUM sp.

The powdered stems had little toxicity to silkworm and Mexican bean beetle larvae, and bean aphids.--Lee and Hansberry (129).
The powdered stems were nontoxic to bean aphids.--Chiu and coworkers (48).

GOODYERA PUBESCENS (L.) R. Br. Synonym: Peramium pubescens.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LIPARIS LILIIFOLIA (L.) Richard.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

VANILLA sp.

An aqueous extract of the stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

OROBANCHACEAE

BOSCHNIAKIA GLABRA C. A. Mey.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CISTANCHE PHELIPAEA (Gueldenst.) Cout.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CONOPHOLIS AMERICANA (L.) Wallr.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

OXALIDACEAE

OXALIS AMARA A. St. Hil.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

OXALIS CORNICULATA L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

OXALIS EUROPAEA f. CYMOSA. (Small) Wieg.

An aqueous extract of the whole plant was toxic to American cockroaches.--Heal and coworkers (93).

PANDANACEAE

PANDANUS sp.

An aqueous extract of the aerial roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PAPAVERACEAE

ARGEMONE ALBA Lestib.

An aqueous extract of the stems and leaves was slightly toxic to American cock-

roaches and nontoxic to German cockroaches and milkweed bugs. An alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito.--Heal and coworkers (93).

ARGEMONE MEXICANA L.

An aqueous extract of the seeds was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to the other two species of insects.--Heal and coworkers (93).

ARGEMONE PLATYCERAS Link & Otto.

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

BOCCONIA CORDATA Willd. Synonym: Macleya cordata.

The powdered stems showed little toxicity to silkworm and Mexican bean beetle larvae and bean aphids.--Lee and Hansberry (129).

Water suspensions of the roots and of the leaves and stems were ineffective against Drosophila hydei larvae, but a suspension of the leaves alone was highly toxic to these larvae.--Yamaguchi and coworkers (233).

An acetone extract of the leaves was toxic to Culex pipiens larvae. The toxicity was traced to the water-insoluble portion of the extract.--Yamaguchi and coworkers (232).

BOCCONIA sp.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CHELIDONIUM MAJUS L. Celandine.

Acetone and water extracts of the leaves and stems were ineffective against mosquito larvae.--Hartzell (89).

DENDROMECON RIGIDUM Benth.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Aqueous extracts of the stems and of the roots were both nontoxic to all these insects.--Heal and coworkers (93).

ESCHSCHOLTZIA CALIFORNICA var. CROCEA Jepson.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PAPAVER sp. Poppy.

An acetone extract of the flowers and stems was toxic to mosquito larvae, but a water extract was ineffective. An acetone extract of Dutch poppy seeds was toxic to mosquito larvae, but a water extract was ineffective.--Hartzell (89).

ROMNEYA COULTERI Harv.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SANGUINARIA CANADENSIS L.

An aqueous extract of the roots was nontoxic to American cockroaches.--Heal and coworkers (93).

PASSIFLORACEAE

PASSIFLORA CAERULEA L.

Aqueous extracts of the stems and leaves and of the roots were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PASSIFLORA INCARNATA L.

An aqueous extract of the whole plant was nontoxic to American cockroaches.--Heal and coworkers (93).

PASSIFLORA QUADRANGULARIS L.

An aqueous extract of the leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was nontoxic to both species of cockroaches. Alcohol, petroleum ether, and chloroform extracts of the leaves were toxic to black carpet

beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

SMEATHMANNIA PUBESCENS Soland.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PEDALIACEAE

CERATOTHECA SESAMOIDES Endl.

Aqueous extracts of the capsules, of the whole plant, and of the seeds were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Alcohol and petroleum ether extracts of the capsules were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract of the capsules was nontoxic to all these insects. A chloroform extract of the whole plant was toxic to webbing clothes moth and black carpet beetle larvae only. Alcohol and petroleum ether extracts of the whole plant were nontoxic to all these insects.--Heal and coworkers (93).

SESAMUM INDICUM L. Synonym: S. orientale. Sesame.

Sesamin showed marked synergism with pyrethrins against house flies.--Haller and coworkers (83).

The synergistic action of sesamin against house flies was compared with that of other natural compounds having related structures, such as asarinin and isosesamin.--Haller and coworkers (81, 82).

Aerosol sprays containing 0.9 percent sesame oil and 0.4 percent pyrethrins in dichlorodifluoromethane (Freon - 12) gave complete kill of Culex, Aedes, and Anopheles mosquitoes, bedbugs, and cockroaches, and were highly effective against three species of flies in dairy barns.--Sullivan and coworkers (206).

Aerosols containing pyrethrins and sesame oil were effective against the cheese skipper (Piophila casei).--Billings and coworkers (35).

Acetone and water extracts of the seeds were ineffective against mosquito larvae. Extracts of the flower tops and leaves gave the same results.--Hartzell (89).

The activation of pyrethrins by sesame oil appeared to be dependent mainly upon the sesamin content of the oil, and an increase in the kill of house flies was accompanied by a small increase in the rate of knockdown. However, it was concluded that there is also present a complex of secondary factors which, according to its composition, may increase or decrease the effect of the pyrethrins irresepctive of the presence or absence of sesamin.--Parkin and Green (166).

An aerosol containing 0.4 gram pyrethrins and 0.9 gram sesame oil showed no toxicity to cyclamen mites.--Goodhue and Smith (77).

Both sesamin and sesamin-free sesame oil were good synergists with pyrethrins against Aedes mosquitoes.--David and Bracey (53).

Sesame oil soap was toxic to the sugarcane wooly aphis.--Cheu (45).

Two compounds in sesame oil other than sesamin showed synergistic activity with pyrethrins.--Simanton (198).

A mixture containing 10 percent sesamin and 90 percent pyrethrum was highly toxic to southern armyworms, melonworms, striped blister beetles, and Autographa 00. Pyrethrum powder containing 5 percent sesame oil was toxic to bean leaf rollers, melon worms, polka dot wasp moths, squash bugs, and striped blister beetles, but it was nontoxic to southern armyworms.--Bottger and Jacobson (36).

An aqueous extract of the seeds was toxic to German cockroaches, slightly toxic to American cockroaches, and nontoxic to milkweed bugs.--Heal and coworkers (93).

Sesamin was a very effective synergist for pyrethrins against house flies.--Kerr (114).

PHOENICACEAE(PALMAE)

ARECA CATECHU L.

Acetone and water extracts of the fruit were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of an unidentified portion of the plant was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

ARENGA WESTERHOUTII Griff.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German

cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

BORASSUS FLABELLIFER L.

Aqueous extracts of the seeds and of the dried pulp were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CORYPHA UTAN Lam. Synonym: C. elata.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CRYSOPHILA ARGENTEA Bartlett.

An aqueous extract of the heartwood was toxic to milkweed bugs, slightly toxic to American cockroaches, and nontoxic to German cockroaches. An aqueous extract of the fleshy growing points was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

DAEMONOROPS DRACO (Willd.) Blume. Synonym: Calamus draco. Dragon's blood.

An acetone extract of the seeds was effective against mosquito larvae.--Hartzell (90).

RAPHIA VINIFERA Beauv.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ROYSTONEA BORINQUENA O. R. Cook. Royal palm.

The wood is very susceptible to termites.--Wolcott (225).

SERENOA REPENS (Bartr.) Small. Synonym: S. serrulata.

An aqueous extract of the plant fragments was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SOCRATEA EXORRHIZA (Mart.) Wendl. Synonym: Iriartea exorrhiza.

An aqueous extract of one sample of the leaves was very toxic to German and American cockroaches, while an aqueous extract of another sample of leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches. An alcohol extract of the grass was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

PHRYMACEAE

PHRYMA OBLONGIFOLIA Koidz. Haedokuso.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and chloroform extracts were nontoxic to all these insects. Alcohol, petroleum ether, and chloroform extracts of the fruits were toxic to black carpet beetle larvae only.--Heal and coworkers (93).

Water suspensions of the leaves and flowers and of the roots were highly toxic to Drosophila hydei larvae, but a suspension of the combined leaves, stems, and roots had no effect on the larvae.--Yamaguchi and coworkers (233).

An acetone extract of the leaves and stems, was toxic to Culex pipiens larvae. The toxicity was traced to the water-insoluble portion of the extract.--Yamaguchi and coworkers (232).

The raw or boiled root juice was toxic to Musca domestica adults and larvae, mosquito larvae, and Pieris rapae larvae. Other parts of the plant were only mildly toxic.--Matsuzawa (140).

The leaves and roots were effective against house fly imagoes, Culex larvae, and other insects.--Matsuzawa (141).

In tests with house flies, the insecticidal principle was found to be an unsaturated sterol present in the fresh or dried root. The compound, a stomach poison named "phrymarol", melts at 134°.--Kikutani and Oshima (116).

PHYTOLACCACEAE

AGDESTIS CLEMATIDEA Moc. & Sesse.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GALLESIA GORAZEMA (Vell.) Moq.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PETIVERIA ALLIACEA L.

The plant is used as an insecticide in Nicaragua.--Higbee (94).

The powdered leaves, stems, and roots were nontoxic to Mexican bean beetle larvae and only slightly toxic to silkworm larvae.--Hansberry and Clausen (86).

Some of the plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

The powdered fruits, leaves, stems, and roots each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

An aqueous extract of the whole plant was toxic to German cockroaches and slightly toxic to American cockroaches. A petroleum ether extract of the roots was toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and Anopheles mosquito larvae. Alcohol and chloroform extracts of the roots were nontoxic to all these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

PHAULOTHAMNUS SPINESCENS A. Gray.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PHYTOLACCA ABYSSINICA Hoffm. Synonym: P. dodecandra.

An aqueous extract of the bark was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract of the bark was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Petroleum ether and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

PHYTOLACCA ACINOSA Roxb.

The powdered root gave complete kill of Mexican bean beetle larvae but had little effect on silkworm larvae and bean aphids. Alcohol and chloroform extracts had no effect on silkworm larvae, and these extracts as well as an acetone extract had no effect on bean aphids.--Lee and Hansberry (129).

The powdered stems were nontoxic to bean aphids.--Chiu and coworkers (48).

PHYTOLACCA AMERICANA L. Synonym: P. decandra. Poke, scoke.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

An aqueous extract of the roots had no effect on southern armyworms but killed 54 percent of cabbage aphids.--Jacobson (108).

An aqueous extract of the fruits was toxic to German cockroaches but not to American cockroaches. An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

RIVINIA HUMILIS L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An aqueous extract of the stems and leaves was very toxic to American and German cockroaches and nontoxic to milkweed bugs. Alcohol and chloroform extracts of the whole plant were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A petroleum ether extract was nontoxic to all these insects.--Heal and coworkers (93).

SEGUIERIA sp.

An aqueous extract of the roots was toxic to American cockroaches when injected into

the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PINACEAE

ABIES SIBIRICA Ledeb.

The powdered plant was nontoxic to Ixodes ticks, bedbugs, house flies, Anopheles and Aedes mosquitoes, Dermacentor ticks, and Drosophila.--Olenev (163).

CALLITRIS GLAUCA. Australian cypress pine.

The wood oil was somewhat effective as a repellent against Aedes mosquitoes, but the leaf oil was ineffective.--McCulloch and Waterhouse (142).

The wood oil and leaf oil were nonrepellent to Australian sheep blowflies.--Waterhouse (220).

The wood is immune to termite attack.--Wolcott (224).

Guaiol, present in the heartwood of this species, is a strong insecticide, and the wood is therefore not attacked by white ants.--Erdtman (59).

The wood oil and leaf oil did not synergize pyrethrins in tests against house flies. Guaiol, obtained from the wood oil, did not synergize pyrethrins.--Kerr (114).

CALLITRIS INTRATROPICA.

Guaiol, present in the heartwood of this species, is a strong insecticide, and the wood is therefore not attacked by white ants.--Erdtman (59).

LIBOCEDRUS FORMOSANA.

The heartwood of this tree is resistant to white ants.--Erdtman (59).

CHAMAECYPARIS LAWSONIANA (A. Murr.) Parl.

An aqueous extract of the wood was nontoxic to German and American cockroaches. An alcohol extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito.--Heal and coworkers (93).

CHAMAECYPARIS NOOTKATENSIS (D. Don) Spack.

An aqueous extract of the wood was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHAMAECYPARIS OBTUSA Sieb. & Zucc. Hinoki.

Hinokinin, obtained from the wood, showed greater synergistic action with pyrethrins than did asarinin when tested against Brevicoryne brassicae, Aphis gossypii, and Myzus persicae.--Matsubara (137, 138).

CHAMAECYPARIS THYOIDES (L.) B. S. P. Yellow cedar.

The wood is susceptible to termites.--Wolcott (225).

An alcohol extract of the wood was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

CHAMAECYPARIS sp.

The oil of an unidentified Japanese species killed 100 percent of female horse gnats in 40 minutes when tested as a spray.--Honjo (95).

The oil, but not the tar, repelled Drosophila flies.--Miyadi and Kawaguchi (151).

JUNIPERUS OXYCEDRUS L.

Caryophyllene, present in the wood, offers little protection against termite attack at low concentrations, but 5 percent caryophyllene did prevent termites from eating treated wood for almost four weeks.--Wolcott (224).

JUNIPERUS SABINA L.

An aqueous extract of the needles was nontoxic to German and American cockroaches.--Heal and coworkers (93).

JUNIPERUS VIRGINIANA L. Red cedar.

Termite-susceptible wood impregnated with as little as 1 percent of commercial cedar oil was repellent to termites, but the effect was only temporary. The oil was more repellent than the heartwood from which it was obtained.--Wolcott (224).

A product for painting on closet walls to repel moths contains a powder derived from cedar oil, plus a plastic binder.--Anonymous (22).

An aqueous extract of the wood was nontoxic to German and American cockroaches.--Heal and coworkers (93).

Exposure to the vapor of red cedar oil at 0.6 milligram per liter for one week killed 91 percent of half-grown clothes moth larvae. Concentrations of 1-2 milligrams per liter were effective in shorter periods (8-24 hours).--Huddle and Mills (100).

Experimental and commercial mixtures of the powdered wood and leaf oil were tested for control of Tineola bisselliella, Attagenus piceus, and Anthrenus vorax. The vapor of the oil was not an effective repellent or fumigant against either larvae or adults of any of the insects.--Sweetman and coworkers (207).

LARIX OCCIDENTALIS Nutt. Larch.

The wood is very susceptible to termites.--Wolcott (225).

PICEA SITCHENSIS (Bong.) Carr. Sitka spruce.

The wood is very susceptible to termites.--Wolcott (225).

PICEA sp. Spruce.

Pinoresinol, a constituent of the exudate of spruce, did not synergize pyrethrins against houue flies, nor was it toxic when tested alone.--Haller and coworkers (81).

PINUS ECHINATA Mill. Southern yellow pine.

PINUS MONTICOLA Dougl. Western white pine.

The wood is susceptible to termites.--Wolcott (225).

PINUS OCCIDENTALIS Sw. West Indian pine.

The gummy heartwood is resistant to termites.--Wolcott (226).

PINUS PALUSTRIS Mill. Longleaf pine, southern pine, colophony.

The wood is susceptible to termites.--Wolcott (225).

Colophony and its resin oils are treated with chlorine to form insecticidal products.--Anonymous (23).

Thanite, the thiocyanoacetate of secondary terpene alcohols of this species, was a fly spray activator.--Anonymous (14).

PINUS PONDEROSA Laws. Ponderosa pine.

PINUS STROBUS L. Northern white pine.

The wood is susceptible to termites.--Wolcott (225).

PINUS SYLVESTRIS L. Scotch pine.

This tree possesses some unidentified quality rendering it entirely free of fungal diseases and insect pests.--Aries (28).

Pinosylvin and its monomethyl ester, isolated from the heartwood, are very toxic to insects.--Erdtman (59).

The powdered plant was nontoxic to Ixodes and Dermacentor ticks, bedbugs, house flies, Aedes and Anopheles mosquitoes, and Drosophila.--Olenev (163).

Susceptible woods treated with 0.01 percent pinosylvin were toxic to the West Indian drywood termite for two months, and the woods were not definitely eaten in five months.--Wolcott (228).

PINUS TAEDA L. Loblolly pine.

The wood is very susceptible to termites.--Wolcott (225).

An acetone extract of the seeds was toxic to mosquito larvae.--Hartzell (90).

PINUS VIRGINIANA Mill. Scrub pine.

An acetone extract of the seeds was toxic to mosquito larvae.--Hartzell (90).

PINUS sp. Pine.

The addition of pine tar oil to standard codling moth baits gave promising results.--Van Leeuwen (212).

The chlorinated terpenes of pine oil, at such extreme dilutions as 0.01 percent, were paralyzingly toxic to West Indian drywood termites, and they retained their toxicity for over two months.--Wolcott (224).

The most effective codling moth bait consisted of one quart of standard bait, 0.5 milliliter valeric acid, 1 milliliter nicotine sulfate, and 1 ounce pine tar oil, in a bottle dispenser.--Van Leeuwen (213).

The heavy fraction of pine-root oil is mixed with ammonium hydroxide to increase the dispersion of the oil over the water in insecticidal tests.--Takeda (208).

PSEUDOTSUGA TAXIFOLIA (Poir.) Britt. Douglas fir.

The wood is susceptible to termites.--Wolcott (225).

The heartwood is susceptible to termites.--Scheffer and Duncan (191).

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SEQUOIA SEMPERVIRENS (D. Don) Endl. California redwood.

Termite-susceptible wood impregnated with as little as 1 percent of commercial cedar oil was repellent to termites, but the effect was only temporary. The oil was more repellent than the heartwood from which it was obtained.--Wolcott (224).

A pyrax dust of the alcohol extractive of the bark was nontoxic to armyworms, celery leaf tiers, pea aphids, and two spotted spider mites.--Bottger and Jacobson (36).

A pyrax dust of the alcohol extractive of the bark showed some toxicity to European corn borer larvae. The combined petroleum ether, ethyl ether, and chloroform extractives were nontoxic to house flies.--Jacobson (108).

An aqueous extract of the wood was nontoxic to German and American cockroaches. An alcohol extract of the wood was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and *Aedes* mosquito.--Heal and coworkers (93).

TAXODIUM DISTICHUM (L.) Rich. Southern cypress, taxodium.

The gummy heartwood is very resistant o termites, but the finegrained heartwood s susceptible to attack.--Wolcott (225).

An acetone extract of the whole plant was neffective against mosquito larvae.--Hartzell (90).

THUJA OCCIDENTALIS L.

Ixodes ticks exposed to the vapors of the owdered leaves were killed in 2-4 hours.--Olenev (162).

The powdered leaves killed house flies n 120 minutes.--Olenev (163).

HUJA PLICATA Donn. Western red cedar.

The heartwood is very resistant to fungi nd insects, and its shavings are used as an sect repellent.--Erdtman (59).

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

TSUGA CANADENSIS (L.) Carr. Hemlock.

The wood is very susceptible to termites.--Wolcott (225).

PIPERACEAE

PIPER ADUNCUM L.

The plant is used to repel ants in Haiti.--Higbee (94).

An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PIPER ANGUSTIFOLIUM Ruiz & Pavon. Matico.

An acetone extract of the leaves was ineffective against mosquito larvae.--Hartzell (90).

PIPER BETLE L.

The powdered leaves, as a stomach poison, showed fair toxicity to melonworm larvae but little toxicity to bean leaf beetle adults. As a contact poison, this material had no effect on melonworm larvae, cotton stainer adults, and Australian cockroach nymphs. The powdered stems showed fair toxicity, as a stomach poison, to cotton stainer adults, but were inert to melonworm larvae, bean leaf beetle adults, and Australian cockroach nymphs. The powdered roots showed fair toxicity to melonworm larvae and cotton stainer and bean leaf beetle adults, but no toxicity to Australian cockroach nymphs.--Plank (174).

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PIPER CUBEBA L. f. Cubeb.

An acetone extract of the berries was toxic to mosquito larvae and nontoxic to Mexican bean beetle adults and larvae. An aqueous extract of the berries was ineffective against mosquito larvae.--Hartzell (89).

PIPER GENICULATUM Sw.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

PIPER GUINEENSE Schum. & Thonn. West African pepper.

The powdered berries were toxic to armyworms but not to celery leaf tiers, pea aphids, and two-spotted spider mites.--Bottger and Jacobson (36).

A petroleum ether extractive of the berries was highly toxic to house flies. A quantity of piperine was isolated from the extractive.--Jacobson (108).

PIPER LONGUM L.

An ethyl ether extract of the fruits was effective against mosquito larvae. Piperine, isolated from the fruits, was not effective against the larvae.--Ghokale and coworkers (74).

PIPER METHYSTICUM Forst. f.

Aqueous extracts of the roots and of the roots and leaves were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

PIPER NIGRUM L. Black pepper.

An acetone extract of the berries at a concentration of 4000 p.p.m. was ineffective against Aphis rumicis. Tests made with Mexican bean beetle adults and larvae using 1.2 percent of an acetone extract of the fruits emulsified with 0.5 percent Pentrol in water showed no appreciable mortality. When the pepper was dusted on bean plants and the beetles were placed on the foliage, the mortality obtained was 94 percent.--Hartzell (89).

Piperine is an activator of pyrethrum dusts and is effective in the control of the German cockroach.--Dewey (54).

Addition of 1 gram of black pepper to 200 grams of beans infested with bean weevils protected the beans from attack by these weevils.--Lathrop and Keirstead (128).

Piperine was a synergist with pyrethrins.--Ono (164).

Piperine, the alkaloid found in the dried fruit of black pepper, was more toxic than pyrethrum to house flies. At concentrations of 0.1 percent, piperine gave a 75-percent kill and pyrethrins a 51.1-percent kill, by the Peet Grady method. However, the paralyzing action was less than for sprays containing the same concentration of pyrethrins. Fly sprays containing 0.05 percent piperine and 0.01 percent pyrethrins were more toxic than sprays containing pyrethrins alone at a concentration of 0.1 percent.--Harvill and coworkers (91).

Acetone extracts, but not water extracts, of the dried berries were toxic to mosquito larvae.--Hartzell (89).

PIPER NOVAE-HOLLANDIAE Miq.

An acetone extract of the leaves was very effective against Aedes mosquito larvae.--Anonymous (20).

PIPER TUBERCULATUM Jacq.

Extracts of the seeds or the fruits were highly toxic to mosquito larvae.--Sievers and coworkers (197).

PIPER sp.

The juice of various species of Piper is used in El Salvador against ticks.--Wellman and van Severen (221).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches. A petroleum extract of the roots was toxic to webbing clothes moth and black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and Anopheles mosquito larvae. Alcohol and chloroform extracts of the roots were toxic to black carpet beetle larvae only.--Heal and coworkers (93).

POTHOMORPHE PELTATA (L.) Miq.

Alcohol, petroleum ether, and chloroform extracts of the branchlets and leaves were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

PITTOSPORACEAE

PITTOSPORUM SENACIA Putterl.

Aqueous extracts of the branchlets and leaves and of the roots were very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petro-

leum ether extracts of the branches and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

PITTOSPORUM VIRIDIFLORUM Sims.

An aqueous extract of the bark was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PLANTAGINACEAE

PLANTAGO LANCEOLATA L.

An aqueous extract of the whole plant with fruits was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PLANTAGO MONTICOLA Decne.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A petroleum ether extract of the roots was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Anopheles* mosquito. Alcohol and chloroform extracts of the roots were nontoxic to all these insects and to *Aedes* mosquito larvae.--Heal and coworkers (93).

PLANTAGO sp.

Acetone and water extracts of the seeds vere ineffective against mosquito larvae.--Iartzell (90).

PLUMBAGINACEAE

ARMERIA MARITIMA var. CALIFORNICA (Boiss.) Lawr.

An aqueous extract of the whole plant was lightly toxic to American cockroaches and ontoxic to German cockroaches and milkeed bugs.--Heal and coworkers (93).

IMONIUM CALIFORNICUM (Boiss.) Heller.

An aqueous extract of the whole plant was xic to American cockroaches when incted into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LIMONIUM LIMBATUM Small.

An aqueous extract of the whole plant was toxic to German cockroaches but only slightly toxic to American cockroaches.--Heal and coworkers (93).

PLUMBAGO SCANDENS L.

An aqueous extract of the stems and roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PODOCARPACEAE

PODOCARPUS NAGI (Thunb.) Pilger.

The powdered leaves were nontoxic to bean aphids.--Chiu and coworkers (48).

PODOCARPUS SPICATA R. Br. Matai.

Matairesinol, from the resin of adult trees, slightly synergized pyrethrins in tests against house flies.--Kerr (114).

POLEMONIACEAE

GILIA AGGREGATA (Pursh) Spreng.

An aqueous extract of the whole plant was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

GILIA CAPITATA Sims.

An aqueous extract of the whole plant with flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GILIA DENSIFLORA var. SANCTORA.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PHLOX DRUMMONDII Hook.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

POLEMONIUM CAERULEUM L.

Aqueous extracts of the roots are excellent emulsifiers for the production of insecticidal formulations.--Petrischeva (172).

POLYGALACEAE

BREDEMEYERA FLORIBUNDA Willd.

Saponins of this plant had no effect on Culex fatigans larvae.--Wasicky and coworkers (219).

MONNINA sp.

An aqueous extract of the roots and lower stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

POLYGALA PAUCIFOLIA Willd.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SECURIDACA ELLIPTICA Turcz.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

POLYGONACEAE

ANTIGONON LEPTOPUS Hook. & Arn.

An aqueous extract of the roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

COCCOLOBA CARACASANA Meissn.

An aqueous extract of the stems was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was slightly toxic to American cockroaches only.--Heal and coworkers (93).

COCCOLOBA GRANDIFLORA Lindau.

The wood is resistant to termites.--Wolcott (225).

COCCOLOBA UVIFERA L.

An aqueous extract of the roots was nontoxic to German and American cockroaches. An alcohol extract of the bark was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

ERIOGONUM FLAVUM Nutt.

ERIOGONUM PAUCIFLORUM Pursh.

Aqueous extracts of the branches of each of these species were slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

MUEHLENBECKIA SAGITTIFOLIA Meissn.

An aqueous extract of the branchlets was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

POLYGONUM AUBERTI (L.) Henry. Fleece vine.

Dead Japanese beetles were found under the fleece vine, killed by eating the foliage of the plant.--Gibbon (75).

POLYGONUM AVICULARE L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

POLYGONUM CAESPITOSUM var. LONGISETUM (De Bruyn) Steward.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

POLYGONUM HISPIDUM H. B. K.

An aqueous extract of the upper parts, leaves, and roots was toxic to American cockroaches when injected into the blood

stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

POLYGONUM HYDROPIPER L. Water pepper herb.

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

POLYGONUM LAPATHIFOLIUM L. Synonyms: P. incarnatum, P. nodosum.

The powdered plant was nontoxic to melonworms, southern armyworms, southern beet webworms, and bean leaf rollers.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the whole plant were nontoxic to house flies and codling moth larvae.--Jacobson (108).

The plant showed little toxicity to silkworm and Mexican bean beetle larvae and bean aphids.--Lee and Hansberry (129).

POLYGONUM PERFOLIATUM L. Cut oxhead.

An alcohol extractive of the leaves and stems was nontoxic to house flies and codling moth larvae.--Jacobson (108).

POLYGONUM PUNCTATUM Ell. Synonym: P. acre. Water smartweed, chilillo.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

The powdered plant was nontoxic to melonworms, southern armyworms, southern beet webworms, and bean leaf rollers.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies and codling moth larvae.--Jacobson (108).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

POLYGONUM sp.

The powdered plant was nontoxic to melonworms, southern armyworms, southern beet webworms, and bean leaf rollers.--Bottger and Jacobson (36).

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to house flies, but they were rather effective against codling moth larvae.--Jacobson (108).

RHEUM RIBES L.

An aqueous extract of the fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RUMEX ACETOSELLA L.

RUMEX OBTUSIFOLIUS L.

Aqueous extracts of the whole plant were toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extracts.--Heal and coworkers (93).

RUMEX CRISPUS L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

RUPRECHTIA CORIACEA (Karst.) Blake.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

RUPRECHTIA VIRARU Griseb.

An aqueous extract of the stems and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RUPRECHTIA sp.

The powdered leaves, bark, wood, and roots each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

TRIPLARIS SURINAMENSIS Cham.

The powdered leaves, bark, and wood each showed moderate toxicity to cotton stainer

adults, but were inert to melonworm and diamondback moth larvae, bean leaf beetle adults, and Australian cockroach nymphs. The powdered roots were nontoxic to all these insects.--Plank (174).

PONTEDERIACEAE

PONTEDERIA CORDATA L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PORTULACACEAE

CALYPTRIDIUM UMBELLATUM (Torr.) Greene.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CLAYTONIA VIRGINICA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LEWISIA REDIVIVA Pursh.

An aqueous extract of the whole plant was toxic to German and American cockroaches but nontoxic to milkweed bugs. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

OREOBROMA COTYLEDON (S. Wats.) Howell.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PORTULACA LANUGINOSA Crantz.

An aqueous extract of the stems was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TALINUM AURANTIACUM Engelm.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TALINUM TRIANGULARE Willd.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PRIMULACEAE

ANAGALLIS ARVENSIS L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ANDROSACE PUBERULENTA Rydb.

An aqueous extract of the whole plant was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

ASTEROLINON STELLATUM Hofmgg. & Link.

An aqueous extract of the whole plant was very toxic to American cockroaches and milkweed bugs but not to German cockroaches.--Heal and coworkers (93).

CYCLAMEN ELEGANS Boiss. & Buhse.

An infusion of the bulbs is toxic to several species of insects, especially mites.--Raucourt (182).

DODECATHEON HENDERSONII A. Gray.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

DODECATHEON JEFFREYI Van Houtte.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DOUGLASIA MONTANA A. Gray.

GLAUX MARITIMA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LYSIMACHIA CILIATA L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LYSIMACHIA FOENUM-GRAECUM Hance.

The plant showed little toxicity to silkworm and Mexican bean beetle larvae and bean aphids.--Lee and Hansberry (129).

The powdered plant was nontoxic to bean aphids.--Chiu and coworkers (48).

LYSIMACHIA MAURITIANA Lam.

Water suspensions of the leaves and of the roots were nontoxic to *Drosophila hydei* larvae, but a suspension of the combined leaves, stems, and roots was highly toxic to the larvae.--Yamaguchi and coworkers (233).

LYSIMACHIA NUMMULARIA L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PRIMULA FARINOSA L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PRIMULA OBCONICA Hance.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol and chloroform extracts of the young whole plant were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

SAMOLUS FLORIBUNDUS H. B. K.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PROTEACEAE

FAUREA McNAUGHTONII Phillips.

An aqueous extract of the stem bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GREVILLEA ROBUSTA A. Cunn. Silver oak, Australian oak.

The wood is very susceptible to termites.--Wolcott (225).

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GUEVINA AVELLANA Mol.

Aqueous extracts of the branchlets and leaves and of the fruits were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PANOPSIS YOLOMBO (Posada) Killip.

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

ROUPALA ADIANTIFOLIA Klotzsch.

An aqueous extract of the leaves of a plant thought to be this species was toxic to

American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Aqueous extracts of the branches and leaves and of the bark were nontoxic to all these insects, while an extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PUNICACEAE

PUNICA GRANATUM L. Pomegranate.

A 1,1,2-trichloroethylene extract of pomegranate bark, mixed with soybean oil, is useful as an insecticide.--Saito (190).

QUIINACEAE

QUIINA INDIGOFERA Sandw.

Aqueous extracts of the branches and leaves and of the roots were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RAFFLESIACEAE

CYTINUS HYPOCISTIS L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RANUNCULACEAE

ACONITUM ANTHERA L.

ACONITUM BAICALENSE Turcz.

These species, particularly the fruits and flowers, were toxic to flies, mosquitoes, lice, and bugs (bedbugs?).--Petrischeva (172).

ACONITUM BARBATUM Patr.

Aqueous infusions of the fruits and flowers killed mosquitoes, flies, lice, and bugs (bedbugs?). Flies, cockroaches, and malaria mosquitoes were killed by stomach treatment with the dry powders.--Petrischeva (172).

ACONITUM CHINENSE Sieb. & Zucc.

The powdered root gave complete mortality of Mexican bean beetle larvae, but a water suspension of the root had no effect on bean aphids. An alcohol extract of the root was inert to silkworm larvae.--Lee and Hansberry (129).

ACONITUM COLUMBIANUM Nutt.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ACONITUM EXCELSUM Reichenb.

This plant, particularly the fruits and flowers, was toxic to flies, mosquitoes, lice, and bugs (bedbugs?).--Petrischeva (172).

ACONITUM JAPONICUM var. MONTANUM Nakai.

Water suspensions of the flowers and of the leaves were highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

An acetone extract of the roots and stems was toxic to Culex pipiens larvae. The toxicity was traced to the basic portion of the extract.--Yamaguchi and coworkers (232).

ACONITUM LYCOCTONUM L.

This plant, particularly the fruits and flowers, was toxic to flies, mosquitoes, lice, and bugs (bedbugs?).--Petrischeva (172).

ACONITUM NAPELLUS L.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

Acetone and water extracts of the roots were ineffective against mosquito larvae.--Hartzell (89).

ACONITUM UNCINATUM L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ACONITUM VILLOSUM Reichenb.

The powdered plant showed considerable toxicity to silkworm and Mexican bean beetle

larvae, but it had no effect on bean aphids. Alcohol and chloroform extracts had no effect on silkworm larvae.--Lee and Hansberry (129).

ACONITUM VOLUBILE Koelle.

This plant, particularly the fruits and flowers, was toxic to flies, mosquitoes, lice, and bugs (bedbugs ?).--Petrischeva (172).

ACONITUM sp.

The powdered plant showed considerable toxicity to silkworm and Mexican bean beetle larvae, but it had no effect on bean aphids. Alcohol and chloroform extracts had no effect on silkworm larvae. Petroleum ether, ethyl ether, acetone, carbon tetrachloride, alcohol, and chloroform extracts of the plant were also ineffective against bean aphids.--Lee and Hansberry (129).

ACTAEA ARGUTA Nutt.

An aqueous extract of the rhizomes was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the rhizomes were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

ACTAEA PACHYPODA Ell.

An aqueous extract of the rootstocks was slightly toxic to American cockroaches.--Heal and coworkers (93).

ACTAEA RUBRA (Ait.) Willd.

An aqueous extract of the fruits was very toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the rhizomes was nontoxic to all these insects.--Heal and coworkers (93).

ADONIS VERNALIS L.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

ANEMONE ALTAICA Fisch.

Aqueous infusions of the fresh material were toxic to flies, mosquitoes, lice, and bugs (bedbugs ?).--Petrischeva (172).

ANEMONE CAROLINIANA Walt.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the fruiting heads was nontoxic to all these insects.--Heal and coworkers (93).

ANEMONE CORONARIA L.

A water suspension of the roots was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

ANEMONE CYLINDRICA A. Gray.

An aqueous extract of the stems, leaves, and fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ANEMONE DECAPETALA Ard.

An aqueous extract of the whole plant was highly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Alcohol extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ANEMONE GLOBOSA Nutt.

An aqueous extract of a sample of the whole plant was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs, but an extract of a second sample of whole plant was nontoxic to all these insects.--Heal and coworkers (93).

ANEMONE NIKOENSIS Maxim.

A water suspension of the roots was nontoxic to Drosophila hydei larvae, but a suspension of the leaves and stems was highly toxic to the larvae.--Yamaguchi and coworkers (233).

ANEMONE PATENS var. WOLFGANGIANA (Bess.) Koch.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the stems and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ANEMONE PULSATILLA L. Synonym: Pulsatilla vulgaris. Pulsatilla.

An acetone extract of the whole plant was nontoxic to mosquito larvae.--Hartzell (90).

ANEMONE RADDEANA Regel.

Water suspensions of the leaves and of the leaves and stems were highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

AQUILEGIA CHRYSANTHA A. Gray.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

AQUILEGIA FORMOSA Fisch.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CIMICIFUGA FOETIDA L.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

CIMICIFUGA RACEMOSA (L.) Nutt.

An aqueous extract of the whole plant was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the stems and leaves was slightly toxic to American cockroaches only.--Heal and coworkers (93).

CLEMATIS APIIFOLIA DC.

An acetone extract of the leaves was toxic to Culex pipiens larvae. The toxicity was traced to the water-insoluble portion of the extract.--Yamaguchi and coworkers (232).

CLEMATIS BALDWINII Torr. & Gray.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CLEMATIS CARACASANA H. B. K.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

CLEMATIS DIOICA L.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CLEMATIS LIGUSTICIFOLIA Nutt.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CLEMATIS TERNIFLORA DC.

Water suspensions of the leaves, the leaves and stems, and of the seeds were highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

CLEMATIS sp.

Infusions of three species of fresh *Clematis* were toxic to flies, mosquitoes, lice, and bugs (bedbugs?).--Petrischeva (172).

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

COPTIS TRIFOLIA (L.) Salisb.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

DELPHINIUM AJACIS L. Larkspur.

Acetone extracts of the seeds were toxic to mosquito larvae, but water extracts were nontoxic to the larvae.--Hartzell (89).

A 5-percent solution of the oil and alkaloids from the seeds gave negligible kill of mosquitoes and lacked mosquito ovicidal power, but the alkaloids ware toxic to lice and bedbugs.--Busvine (41).

DELPHINIUM BROWNII Rydb.

The seed oil was promising as an insecticide for mosquitoes and potato beetles. It is not expected to excel nicotine sulfate as a contact insecticide but may prove to be a superior stomach poison and repellent.--Stultz and Patterson (203).

DELPHINIUM CHEILANTUM Fisch.

Aqueous infusions, particularly of the flowers and fruits, were toxic to flies, mosquito larvae, lice, cockroaches, and bugs (bedbugs?).--Petrischeva (172).

DEIPHINIUM DELAVAYI Franch.

The powdered plant showed considerable toxicity to Mexican bean beetle larvae but had little effect on silkworm larvae and bean aphids. Alcohol and chloroform extracts had no effect on silkworm larvae or bean aphids. An acetone extract was ineffective against bean aphids.--Lee and Hansberry (129).

DELPHINIUM DICTYOCARPUM DC.

Aqueous infusions, particularly of the flowers and fruits, were toxic to flies, mosquito larvae, lice, cockroaches, and bugs (bedbugs?).--Petrischeva (172).

DELPHINIUM ELATUM L.

The seed extracts were toxic to lice and bedbugs.--Busvine (41).

An aqueous infusion of the flowers and fruits was very toxic to malaria mosquito larvae, flies, lice, bugs (bedbugs?), cockroaches, and ants.--Petrischeva (172).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

DELPHINIUM FORMOSUM Boiss. & Huet.

The seed extracts were toxic to lice and bedbugs.--Busvine (41).

DELPHINIUM GRANDIFLORUM L.

Aqueous infusions, particularly of the flowers and fruits, were toxic to flies, mosquito larvae, lice, cockroaches, and bugs (bedbugs?).--Petrischeva (172).

DELPHINIUM LAXIFLORUM DC.

Aqueous infusions of the flowers and fruits were very toxic to malaria mosquito larvae, flies, lice, bugs (bedbugs?), cockroaches, and ants.--Petrischeva (172).

The plant is used against lice and bedbugs.--Busvine (41).

DELPHINIUM OCCIDENTALE S. Wats. Tall larkspur.

The crystalline alkaloid deltaline, isolated from this plant, was nontoxic to southern armyworm larvae.--Jacobson (108).

DELPHINIUM RETROPILOSUM.

Aqueous infusions, particularly of the flowers and fruits, were toxic to flies, mosquito larvae, lice, cockroaches, and bugs (bedbugs?).--Petrischeva (172).

DELPHINIUM STAPHISAGRIA L.

Acetone and water extracts were nontoxic to mosquito larvae.--Hartzell (89).

The plant is used against lice and bedbugs.--Busvine (41).

An aqueous extract of the seeds was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the seeds were toxic

to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

DELPHINIUM VIRESCENS Nutt.

An aqueous extract of the whole plant was toxic to German cockroaches and milkweed bugs, but not to American cockroaches. An aqueous extract of the seeds was toxic to all these insect species.--Heal and coworkers (93).

DELPHINIUM sp. Larkspur.

The powdered seeds are used to destroy head lice and garden worms.--Higbee (94).

The powdered leaves, stems, and seeds were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

The powdered roots were toxic to bean leaf rollers, cross-striped cabbageworms, cabbage loopers, and melonworms, but not to southern armyworms.--Bottger and Jacobson (36).

The powdered roots were nontoxic to southern armyworms, cross-striped cabbageworms, and Autographa 00, but they were toxic to melonworms and European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives of the roots were nontoxic to house flies and German cockroaches, but they were rather effective against codling moth larvae.--Jacobson (108).

ERANTHIS HYEMALIS L. Winter aconite.

The powdered rhizomes gave complete mortality of diamondback moth larvae, but alcohol, acetone, or benzene extracts of the rhizomes and of the stems and leaves showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

HEPATICA NOBILIS var. NIPPONICA.

A water suspension of the leaves, stems, flowers, and roots was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

ISOPYRUM STOLONIFERUM Maxim.

A water suspension of the leaves, stems, and roots was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

PAEONIA BROWNII Dougl.

An aqueous extract of the fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was nontoxic to all these insects. Petroleum ether and chloroform extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract of the roots was toxic to webbing clothes moth larvae only.--Heal and coworkers (93).

RANUNCULUS FLAGELLIFORMIS Sm.

A water suspension of the leaves, stems, and roots was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

RANUNCULUS MIRISSIMUS Hisauchi.

A water suspension of the leaves, stems, and roots was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

RANUNCULUS SCELERATUS L.

Water suspensions of the leaves, roots, and combined stems, leaves, and roots were all highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

RANUNCULUS VERNYII var. GLABER Nakai.

A water suspension of the leaves was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

RANUNCULUS VERNYII var. QUELPAERTENSIS Nakai.

A water suspension of the leaves, stems, and roots was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

RANUNCULUS ZUCCARINI Miq.

A water suspension of the leaves, flowers, and roots was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

RANUNCULUS sp.

An aqueous extract of the whole plant was nontoxic to German and American cock-

roaches and milkweed bugs.--Heal and coworkers (93).

THALICTRUM AQUILEGIFOLIUM L. var. JAPONICUM.

A water suspension of the leaves and stems showed some toxicity to Drosophila hydei larvae, but a suspension of the roots was nontoxic.--Yamaguchi and coworkers (233).

THALICTRUM REVOLUTUM DC.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TRAUTVETTERIA CAROLINIENSIS (Walt.) Vail.

An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

XANTHORHIZA SIMPLICISSIMA Marsh.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RAPATEACEAE

RAPATEA PALUDOSA Aubl.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RHAMNACEAE

ADOLPHIA INFESTA Meissn.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CEANOTHUS AMERICANUS L. Jersey tea.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

COLIETIA CRUCIATA Gill. & Hook.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

COLUBRINA ASIATICA (L.) Brongn.

An aqueous extract of the stems and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

DISCARIA LONGISPINA Miers.

Aqueous extracts of the roots and of the stems were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

KARWINSKIA sp.

An aqueous extract of the fruits was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth, black carpet beetle, and Aedes mosquito.--Heal and coworkers (93).

KRUGIODENDRON FERREUM (Vahl) Urban. Black ironwood.

The wood is very resistant to termites.--Wolcott (225).

REYNOSIA UNCINATA Urban.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RHAMNUS CAROLINIANUS Walt.

An aqueous extract of the fruits was slightly toxic to American cockroaches and

nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RHAMNUS CRENATUS Sieb. & Zucc.

The powdered stems and roots showed little toxicity to silkworm and Mexican bean beetle larvae and to bean aphids.--Lee and Hansberry (129).

The powdered roots were toxic to bean aphids.--Chiu and coworkers (48).

RHAMNUS FRANGULA L. Buckthorn.

An acetone extract of the bark was ineffective against mosquito larvae.--Hartzell (90).

RHAMNUS LANCEOLATUS Pursh.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RHAMNUS PURSHIANUS DC. Cascara sagrada.

Acetone and water extracts of the bark were ineffective against mosquito larvae.--Hartzell (89).

VENTILAGO MADRASPATANA.

An aqueous extract of the bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ZIZYPHUS JOAZEIRO Mart.

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

RHIZOPHORACEAE

ANISOPHYLLEA FRUTICULOSA Engl. & Gilg.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the roots was slightly toxic to American cockroaches only.--Heal and coworkers (93).

RHIZOPHORA MANGLE L. Red mangrove.

The heartwood and sapwood are both susceptible to termites.--Wolcott (225).

RHIZOPHORA sp. Barbasco mangle.

An acetone extract of the bark was nontoxic to mosquito larvae.--Jacobson (108).

ROSACEAE

AGRIMONIA EUPATORIA L. Agrimony herb.

Acetone and water extracts of the whole plant were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CERCOCARPUS LEDIFOLIUS Nutt.

An aqueous extract of the branchlets, leaves, and bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CHAENOMELES LAGENARIA (Loisel.) Koidz.

An aqueous extract of the branchlets, leaves, and fruits was nontoxic to American and German cockroaches.--Heal and coworkers (93).

CHAMAEBATIA FOLIOLOSA Benth.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CHAMAEBATIANA MILLEFOLIUM (Torr.) Maxim.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COWANIA STANSBURIANA Torr.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the stem bark was slightly toxic to American cockroaches only.--Heal and coworkers (93).

CYDONIA OBLONGA Mill. Quince.

Acetone and water extracts of the seeds were ineffective against mosquito larvae.--Hartzell (89).

GILLENIA STIPULATA (Muhl.) Baill.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches.--Heal and coworkers (93).

HAGENIA ABYSSINICA J. F. Gmel. Kousso.

Acetone and water extracts of the flowers were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the fragments of the plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

KERRIA JAPONICA (L.) DC.

An aqueous extract of the branchlets and .eaves was nontoxic to German and Ameri-can cockroaches.--Heal and coworkers (93).

.ICANIA DENSIFLORA Kleinh.

The wood is resistant to termites.--Volcott (225).

IALUS SYLVESTRIS L. Winesap apple, Stayman Winesap apple.

Tests against codling moth larvae using nixtures of lead arsenate and an alcohol xtract of apple peels indicated the presence n the peel of a constituent that either is ttractive to the larvae or acts as a syn-rgist with the lead arsenate.--Siegler and ones (195).

ARINARIUM sp.

An aqueous extract of the branchlets and aves was toxic to American cockroaches nen injected into the blood stream, but erman cockroaches and milkweed bugs ere unaffected after immersion in the tract. An aqueous extract of the seeds s nontoxic to all these insects.--Heal d coworkers (93).

UNUS AMERICANA Marsh.

The leaves and flowers were toxic to ects.--Pan (165).

PRUNUS AMYGDALUS Stokes. Bitter almond.

Almond oil was slightly repellent to the sheep blowfly.--Mackerras and Mackerras (134).

PRUNUS BUERGERIANA Miq.

A water suspension of the leaves and stems was highly toxic to *Drosophila hydei* larvae.--Yamaguchi and coworkers (233).

PRUNUS GRAYANA Maxim.

A water suspension of the leaves and stems was highly toxic to *Drosophila hydei* larvae, but a suspension of the leaves, stems, and flowers was ineffective against these larvae.--Yamaguchi and coworkers (233).

PRUNUS JAPONICA Thunb.

A water suspension of the leaves and flowers was highly toxic to *Drosophila hydei* larvae.--Yamaguchi and coworkers (233).

PRUNUS LAUROCERASUS L. Synonyms: *Padus laurocerasus, Laurocerasus officinalis*. Cherry laurel.

The volatile fractions of the leaves were extremely toxic to *Ixodes ricinus* and to a variety of flies, fleas, and bedbugs.--Olenev (162).

The powdered leaves were very toxic to *Ixodes* ticks, *Dermacentor pictus, Hyalomma asiaticum*, house flies, bedbugs, *Aedes* and *Anopheles* mosquitoes, and *Drosophila* adults.--Olenev (163).

PRUNUS MAACKII Rupr.

The powdered flowers killed *Cimex lectularius* and *Aedes punctor* adults in three minutes and one minute respectively. The powdered bark killed *Aedes* adults in one minute.--Olenev (162).

PRUNUS PADUS L. Synonyms: *Padus racemosa, Padus vulgaris, Cerasus padus*. European bird cherry, black currant.

Infusions of the fresh plant were toxic to flies, mosquitoes, lice, and bugs (bedbugs?).--Petrischeva (172).

Insects placed in close contact with the leaves and blossoms were killed after 1-15 minutes' exposure. Tested were gnats, midges, horse flies, and house flies. The

volatile fractions were probably the active materials.--Kiseleva (117).

Applications of hot water extracts combined with the wearing of collars woven from the steamed branches lead to the delousing of cattle within 3-4 days, the effect lasting for several months. There was no indication that the insects were killed by the treatment.--Gurai (80).

The powdered buds, bark, and leaves were very toxic to Ixodes and Dermacentor ticks, Hyalomma asiaticum, house flies, bedbugs, Aedes and Anopheles mosquitoes, and Drosophila adults.--Olenev (163).

Volatile fractions of the buds and of the bark were toxic to Ixodes and Argas ticks, flies, fleas, and bedbugs.--Olenev (162).

PRUNUS PERSICA (L. Batsch). Synonym: Amygdalus persica. Peach.

The leaves and flowers were toxic to insects.--Pan (165).

Acetone and water extracts of the leaves were ineffective against mosquito larvae.--Hartzell (89).

PRUNUS SEROTINA Ehrh. Wild cherry.

Acetone and water extracts of the bark were nontoxic to mosquito larvae.--Hartzell (89).

Alcohol extracts of the fresh green leaves, shade- and sun-dried leaves, fruits, roots, trunk, branches, and twigs were all ineffective as repellents against Aedes aegypti mosquitoes, as larvicides against Anopheles quadrimaculatus mosquitoes, and as body lousicides.--Jacobson (108).

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PURSHIA TRIDENTATA (Pursh) DC.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the branchlets, leaves, and flowers was nontoxic to all these insects. Alcohol, petroleum ether, and chloroform extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ROSA sp.

The powdered roots were nontoxic to bean aphids.--Chiu and coworkers (48).

RUBUS JAPONICUS Focke.

A water suspension of the leaves, stems, and roots was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

RUBUS sp. Blackberry.

An acetone extract of the root bark was ineffective against mosquito larvae.--Hartzell (90).

SANGUISORBIA CANADENSIS L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SANGUISORBIA MINOR Scop.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. The petroleum ether extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. Alcohol and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

SANGUISORBIA OFFICINALIS L.

The powdered roots showed little toxicity to silkworm and Mexican bean beetle larvae and to bean aphids.--Lee and Hansberry (129).

SPIRAEA NIPPONICA Maxim.

A water suspension of the leaves and stems was highly toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

RUBIACEAE

ADINA CORDIFOLIA (Willd.) Benth. & Hook.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ASPERULA ODORATA L. Sweet woodruff.

Acetone and water extracts of the leaves and stems were ineffective against mosquito larvae.--Hartzell (89).

BASANACANTHA ANNAE K. Schum.

An aqueous extract of the bark was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

BORRERIA VERTICILLATA (L.) G. F. W. Mey.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CEPHAELIS ACUMINATA Karst. Ipecac.

Acetone and water extracts of the roots were ineffective against mosquito larvae.--Hartzell (89).

CEPHALANTHUS OCCIDENTALIS L.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CHIOCOCCA ALBA (L.) Hitchc.

An aqueous extract of the roots was non-oxic to German and American cock-roaches.--Heal and coworkers (93).

CINCHONA LEDGERIANA Moens. Peruvian bark.

The powdered bark, wood, and roots were ach moderately toxic, as stomach poisons, ut not as contact poisons, to melonworm nd diamondback moth larvae, but they ere inert to cotton stainer and bean leaf eetle adults and Australian cockroach ymphs. The powdered leaves were nontoxic o all these insects.--Plank (174).

OFFEA ARABICA L. Coffee.

The wood is very susceptible to ter-ites.--Wolcott (225).
An insecticide can be made from coffee ulp.--Anonymous (26).

OPROSMA AUSTRALIS (A. Rich.) B. L. Robinson.

An aqueous extract of the twigs was non-xic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COPROSMA BAUERI Endl.

An aqueous extract of the bark was slightly toxic to American cockroaches and milkweed bugs.--Heal and coworkers (93).

COPROSMA LUCIDA Forst.

Aqueous extracts of the bark and of the twigs were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

COPROSMA ROBUSTA Raoul.

Aqueous extracts of the bark and of the twigs and leaves were nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract of the bark was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts of the bark were nontoxic to all these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

CORYNANTHE JOHIMBE K. Schum.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DANAIS FRAGRANS Gaertn. f.

An aqueous extract of the branches and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

EXOSTEMA CARIBAEUM (Jacq.) R. & S.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

FARAMEA CANDELABRUM Standl.

An aqueous extract of the stems and roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

FERDINANDUSA RUDGEOIDES Wedd.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

GALIUM APARINE L. Cleaver's herb, bedstraw.

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

GARDENIA JASMINOIDES Ellis.

An aqueous extract of the fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

GARDENIA LUTEA Fresen.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the fruits was toxic to American cockroaches only.--Heal and coworkers (93).

GENIPA AMERICANA L.

The wood is very susceptible to termites.--Wolcott (225).

Alcohol, petroleum ether, and chloroform extracts of the leaves were nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

GENIPA sp.

A petroleum ether extract of the fruits was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes mosquito. Alcohol and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

GONZALAGUNIA PANAMENSIS Pers.

An aqueous extract of the leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

HAMALIA PATENS Jacq.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

HEINSIA PULCHELIA (G. Don.) K. Schum.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

HOUSTONIA LANCEOLATA (Poir.) Britton.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LADENBERGIA MAGNIFOLIA (Ruiz & Pavon) Klotzsch.

An aqueous extract of the bark and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

LAUGERIA RESINOSA Vahl.

The wood is susceptible to termites.--Wolcott (225).

MITCHELLA REPENS L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

MITRACARPUS PORTORICENSIS Urban.

MITRACARPUS VERTICILLATUS (Schum. & Thonn.) Vatke.

Aqueous extracts of these species were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MORELIA SENEGALENSIS A. Rich.

Aqueous extracts of the bark and of the branches and leaves were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MORINDA CITRIFOLIA L.

NENAX MICROPHYLLA (Sond.) Salter.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PAEDERIA FOETIDA L.

An aqueous extract of the stems was nontoxic to German and American cock-

roaches and milkweed bugs.--Heal and coworkers (93).

PALICOURIA GUIANENSIS Aubl.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An aqueous extract of the roots was nontoxic to all these insects.--Heal and coworkers (93).

PALICOURIA MARCGRAVII St. Hil.

An aqueous extract of the herbage and upper parts was nontoxic to German and American cockroaches. An aqueous extract of the roots was nontoxic to these insects.--Heal and coworkers (93).

PALICOURIA RIPARIA Benth.

An aqueous extract of the branches and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

PSYCHOTRIA SUTERELLA Muell. Arg.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RANDIA DUMETORUM Lam.

The powdered roots showed considerable toxicity to diamondback moth larvae. Acetone extracts of the kernel and shell and of the roots, stems, and leaves showed no appreciable contact toxicity to bean aphids, sawtoothed grain beetles, and Ahasverus advena.--Tattersfield and coworkers (209).

An aqueous extract of the fruits was highly toxic to German and American cockroaches and milkweed bugs. Aqueous extracts of the branchlets and leaves and of the roots were nontoxic to all these insects. Alcohol, petroleum ether, and chloroform extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Extracts of the fruits were toxic to black carpet beetle larvae and showed some toxicity to the webbing clothes moth.--Heal and coworkers (93).

RANDIA ECHINOCARPA DC.

An aqueous extract of the fruits was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RANDIA NILOTICA Stapf.

The powdered roots gave complete mortality of diamondback moth larvae. Acetone extracts of the bark and wood showed no appreciable contact toxicity to bean aphids, saw-toothed grain beetles, and Ahasverus advena.--Tattersfield and coworkers (209).

REMIFIA TENUIFLORA Benth.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

RUBIA TINCTORUM L. Madder.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

Alizarin, obtained from this plant, was quite repellent to termites.--Wolcott (224).

SARCOCEPHALUS CORDATUS Miq.

An aqueous extract of the stem bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

SARCOCEPHALUS DIDERICHII DeWild.

An aqueous extract of the wood was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SICKINGIA TINCTORIA (H. B. K.) K. Schum.

An aqueous extract of the wood was nontoxic to German and American cockroaches. An alcohol extract of the wood was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito.--Heal and coworkers (93).

STRUMPFIA MARITIMA Jacq.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

UNCARIA GAMBIR Roxb. Synonym: Ouroupariagambir.

An aqueous extract of the gum was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RUTACEAE

AMYRIS BALSAMIFERA L.

Caryophyllene, present in the wood, offers little protection against termite attack at low concentrations, but 5-percent caryophyllene did prevent termites from eating treated wood for almost four weeks.--Wolcott (224).

AMYRIS ELEMIFERA L. Synonym: A. sylvatica Jacq. Torchwood.

Termites will not even come to rest on the heartwood of this tree.--Wolcott (224).

An aqueous extract of the wood was nontoxic to German and American cockroaches. An alcohol extract of the wood was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito.--Heal and coworkers (93).

BAROSMA SERRATIFOLIA Willd. Buchu.

An acetone extract of the leaves was ineffective against mosquito larvae.--Hartzell (90).

BOENNINGHAUSENIA ALBIFLORA Reichenb. var BREVIPES.

The powdered plant was nontoxic to bean aphids.--Chiu and coworkers (48).

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BOENNINGHAUSENIA JAPONICA Nakai.

A water suspension of the leaves was nontoxic to Drosophila hydei larvae, but a suspension of the roots was highly toxic to the larvae.--Yamaguchi and coworkers (233).

CASIMIROA EDULIS Llav.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHOISYA DUMOSA (Torr.) A. Gray.

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CITRUS BERGAMIA Risso.

An aqueous extract of the pulp was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CITRUS LIMETTA Risso.

An aqueous extract of the rind was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CITRUS LIMON (L.) Burm. f. Lemon.

Powdered lemon rind killed Ixodes ticks in 17 minutes when the insects were exposed to the vapors. When placed in the juice, the insects died in 7-10 minutes.--Olenev (162).

An aqueous extract of the pulp was nontoxic to German and American cockroaches, while an extract of the rind was toxic to German cockroaches only.--Heal and coworkers (93).

CITRUS MEDICA L.

An aqueous extract of the pulp was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CITRUS SINENSIS (L.) Osbeck. Orange.

Oil of orange was ineffective against oystershell scale, Mexican mealybugs, and willow scurfy scale.--Cressman and Dawsey (51).

The wood is very susceptible to termites.--Wolcott (225).

Orange peelings are used in El Salvador as bait to attract leaf-cutting ants away from valued growing crops.--Wellman and van Severen (221).

Drosophila funebris adults exposed to the vapors of powdered orange rind were killed in 20-25 minutes.--Olenev (162).

CLAUSENA ANISATA Hook. f.

The plant is used as a mosquito repellent.--Meyer (148).

CNEORIDIUM DUMOSUM (Nutt.) Hook. f.

An aqueous extract of the branches and leaves was toxic to American cockroaches

when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CUSPARIA ANGOSTURA (Rich.) Lyons.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

DICTYOLOMA PERUVIANUM Planch.

DICTYOLOMA sp.

Aqueous extracts of the leaves were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A chloroform extract of the leaves was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and petroleum ether extracts were nontoxic to all these insects.--Heal and coworkers (93).

DICTYOLOMA VANDELLIANUM A. Juss. Synonym: D. incanescens DC.

An aqueous extract of the stem bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ERIOSTEMON CROWEI F. Muell. Synonym: Crowei saligna.

Croweacin, obtained from the essential oil of the leaves and stems, markedly increased the toxicity of a standard pyrethrum spray to house flies.--Kerr (114).

EUXYLOPHORA PARAENSIS Huber. Brazilian satinwood.

The wood is resistant to termites.--Wolcott (225).

EVODIA DANIELLII (Benn.) Hemsl.

An aqueous extract of the fruits was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

EVODIA HUPENSIS Dode.

An aqueous extract of the branches and leaves was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae only, while alcohol and chloroform extracts were nontoxic to all insects tested.--Heal and coworkers (93).

EVODIA LITTORALIS Endl.

Evodionol, a compound isolated from the leaves and closely related in structure to the rotenoids deguelin, toxicarol, and tephrosin, was a very effective synergist with pyrethrins against house flies.--Kerr (114).

FAGARA MANTCHURICA (Bennett) Honda.

An acetone extract of the fruits was toxic to Culex pipiens larvae. The toxicity was traced to the water-insoluble portion of the extract.--Yamaguchi and coworkers (232).

HELIETTA LONGIFOLIATA Britton.

An aqueous extract of the stem bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LUNASIA AMARA Blanco.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

MELICOPE ERYTHROCOCCA Benth.

An aqueous extract of the seeds was toxic to milkweed bugs, slightly toxic to American cockroaches, and nontoxic to German cockroaches. An aqueous extract of the branchlets and leaves was nontoxic to all these insects. Petroleum ether and chloroform extracts of the branches and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and

Aedes and Anopheles mosquitoes. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

METRODOREA PUBESCENS A. St. Hil. & Tul.

An aqueous extract of the seeds was very toxic to American cockroaches and milkweed bugs but not to German cockroaches. Alcohol, petroleum ether, and chloroform extracts of the seeds, roots, and branches and leaves were all toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

MONNIERIA TRIFOLIA L.

An aqueous extract of the roots was nontoxic to American cockroaches.--Heal and coworkers (93).

ORIXA JAPONICA Thunb.

Water suspensions of the leaves and of the flowers were nontoxic to Drosophila hydei larvae, but a suspension of the combined leaves and seeds was highly toxic to the larvae.--Yamaguchi and coworkers (233).

PHELLODENDRON AMURENSE Rupr. Amur cork tree, velvet tree.

Acetone extracts of the fruits and of the bark were toxic to Culex pipiens larvae. In each case, the toxicity was traced to the water-insoluble portion of the extract.--Yamaguchi and coworkers (232).

PHELLODENDRON LAVALLEI Dode.

An aqueous extract of the fruits was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

PHELLODENDRON sp.

The powdered plant was nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

PILOCARPUS JABORANDI Holmes. Jaborandi.

PILOCARPUS MICROPHYLLUS Stapf.

Acetone extracts of the leaves were toxic to mosquito larvae.--Hartzell (90).

PILOCARPUS PENNATIFOLIUS Lem.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PTELEA TRIFOLIATA L.

Acetone and water extracts of the root bark were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

RUTA CHALAPENSIS L.

An aqueous extract of the whole plant was toxic to German cockroaches but not to American cockroaches.--Heal and coworkers (93).

RUTA GRAVEOLENS L. Rue.

An acetone extract of the whole plant was toxic to mosquito larvae.--Hartzell (90).

Aqueous extracts of the stems and leaves and of the whole plant were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SKIMMIA JAPONICA var. RUGOSA.

A water suspension of the leaves and stems was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

SKIMMIA LAUREOLA Thunb.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

THAMNOSMA MONTANA Torr. & Frem.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

THAMNOSMA TEXANA Torr.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ZANTHOXYLUM AMERICANUM Mill. Northern prickly ash.

Petroleum ether extracts of the bark and of the wood exhibited neither toxicity to house flies nor synergism with the pyrethrins. The powdered bark was ineffective against southern armyworms, melonworms, and bean leaf rollers.--Jacobson (108).

ZANTHOXYLUM CLAVA-HERCULIS L. Synonyms: Z. carolinianum, Fagara caroliniana. Southern prickly ash, Hercules club, toothache tree.

A semi-solid material, obtained by purification of the petroleum ether extractive of the bark, was highly toxic to house flies.--LaForge and coworkers (125).

Asarinin, isolated from the bark, greatly increased the toxicity of pyrethrum to house flies.--Haller and coworkers (81).

Asarinin was as effective a synergist as sesamin when tested with pyrethrins against house flies.--Haller and coworkers (82).

A semi-solid material, obtained by purification of the petroleum ether extractive of the bark, was highly toxic to house flies either alone or in admixture with a diluent such as clay, talc, or bentonite. The insecticidal material may also be obtained from the roots, fruits, or leaves of the plant.--LaForge and Haller (124).

Acetone, but not water, extracts of the bark were toxic to mosquito larvae. The acetone extract at a concentration of 4000 p.p.m. was ineffective against Aphis rumicis.--Hartzell (89).

The petroleum ether extract of the bark was nontoxic to the cyclamen mite, Tarsonemus pallidus, when tested as a methyl chloride aerosol.--Goodhue and Smith (77).

An amide, N-(2-p-anisylethyl)-N-methylcinnamamide, isolated from the petroleum ether extractive of the bark, was nontoxic to house flies.--LaForge and Barthel (123).

Herculin, a pungent amide isolated from the petroleum ether extractive of the bark, was as effective against house flies as the pyrethrins.--Jacobson (105).

A mixture of 10 percent asarinin and 90 percent pyrethrins was toxic to melonworms, southern armyworms, Autographa 0, and striped blister beetles. The powdered bark was toxic to armyworms, bean leaf rollers, and melonworms, but not to celery leaf tiers, pea aphids, and two-spotted spider mites. A 25-percent pyrax dust of the combined ethyl ether, chloroform, and alcohol extractives of the petroleum ether-extracted bark was nontoxic to armyworms, pea aphids, and celery leaf tiers.--Bottger and Jacobson (36).

The petroleum ether extractive of the bark was toxic to house flies, lone star ticks, and mosquito larvae, and it was an effective body louse ovicide, but it was nontoxic to dog and cat fleas, chiggers, and adult body lice, and as a mosquito repellent. The combined ethyl ether, chloroform, and alcohol extractives of the petroleum ether-extracted bark were nontoxic to European corn borer larvae.--Jacobson (108).

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ZANTHOXYLUM FLAVUM Vahl. Synonym: Fagara flavum. Satinwood.

The wood is resistant to termites.--Wolcott (225).

An aqueous extract of the stems was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ZANTHOXYLUM MAVIENSE H. Mann var. ANCYSS.

An aqueous extract of the leaves was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ZANTHOXYLUM NARANJILLO Griseb.

An aqueous extract of the branchlets was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ZANTHOXYLUM PIPERITUM DC.

Acetone extracts of the bark and of the root bark were toxic to Culex pipiens larvae. The toxicity was traced to the water-soluble and water-insoluble portions of the extracts, respectively.--Yamaguchi and coworkers (232).

In tests with sanshool-I (N-isobutyl-2,4,8-dodecatrienamide) and sanshool II (N-isobutyl-2,4,8,10-dodecatetraenamide), pungent principles isolated from the bark of this plant, the former killed 8 out of 10 Culex pipiens larvae in 2 hours and 10 out of 10 in 16 hours at 1 to 30,000. The latter

killed 3 out of 10 and 10 out of 10 in 2 and 16 hours, respectively. At 1 to 100,000, sanshool-I and sanshool-II killed 10 out of 10 and 3 out of 10, respectively, in 24 hours. Both were ineffective at 1 to 300,000.--Aihara and Suzucki (6).

ZIERIA SMITHII Andr.

The essential oil was highly repellent to Aedes and Anopheles mosquitoes and to Australian sheep blowflies, but it was ineffective against the bush fly, Musca vetustissima. The active constituents are elemicin and methyleugenol.--McCulloch and Waterhouse (142).

The leaf essential oil was very effective in synergizing pyrethrins in tests against house flies. Elemicin, methyleugenol, and safrole probably account for the action of the oil. Neither linalool nor a distillation fraction consisting of 50 percent carene epoxide and 50 percent pinene was synergistic.--Kerr (114).

SABIACEAE

MELIOSMA sp.

An aqueous extract of the branches and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was slightly toxic to American cockroaches only.--Heal and coworkers (93).

SALICACEAE

POPULUS CANDICANS Ait. Poplar.

Pyrax dusts of the ethyl ether and alcohol extractives of the buds were toxic to armyworms but not to celery leaf tiers, pea aphids, and two-spotted spider mites.--Bottger and Jacobson (36).

The same pyrax dusts as mentioned above were nontoxic to European corn borer larvae. The ethyl ether extractive had no effect on cat fleas, lone star ticks, chiggers, body lice, and Anopheles mosquito larvae, and as a body louse ovicide. This extractive as well as the alcohol extractive were both nontoxic to house flies.--Jacobson (108).

An aqueous extract of the buds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

POPULUS NIGRA L. Black poplar.

An aqueous extract of the leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

POPULUS TREMULOIDES Michx.

An acetone extract of the bark was nontoxic to mosquito larvae.--Hartzell (90).

SALIX CHILENSIS Mol. Humboldt's willow.

The wood is very susceptible to termites.--Wolcott (225).

SALIX NIGRA Marsh. Black willow.

An acetone extract of the buds was nontoxic to mosquito larvae.--Hartzell (90).

SALIX sp. Willow.

An acetone extract of the bark was nontoxic to mosquito larvae.--Hartzell (90).

SALVADORACEAE

SALVADORA PERSICA L.

Aqueous extracts of the leaves and of the roots were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SANTALACEAE

ACANTHOSYRIS SPINESCENS Griseb.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BUCKLEYA DISTICHOPHYLLA (Nutt.) Torr.

Aqueous extracts of the whole plant and of the fruits were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EUCARYA SPICATA (R. Br.) Sprague & Somm. Sandalwood.

The essential oil and the resin oil are not repellent to Aedes mosquitoes.--McCulloch and Waterhouse (142).

The essential oil of the wood did not synergize pyrethrins in tests against house flies.--Kerr (114).

EXOCARPUS CUPRESSIFORMIS Labill.

An aqueous extract of the stem bark was toxic to American cockroaches when injected into the blood stream, but German

cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

IODINA RHOMBIFOLIA Hook. & Arn.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

OSYRIS ARBOREA Wall. Synonym: O. wightiana.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PYRULARIA PUBERA Michx.

Aqueous extracts of the bark, of the fruits and roots, and of the roots were each highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol, petroleum ether, and chloroform extracts of the bark were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. An alcohol extract of the fruits was toxic only to black carpet beetle larvae, while petroleum ether and chloroform extracts were nontoxic to all these insects. Alcohol and petroleum ether extracts of the roots were toxic only to black carpet beetle larvae and a chloroform extract was nontoxic to all these insects. An aqueous extract of the branches and leaves was slightly toxic to American cockroaches while an aqueous extract of the fruits was quite toxic to these insects. Petroleum ether and chloroform extracts of the branches and leaves were toxic to black carpet beetle larvae only, and an alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

SANTALUM ALBUM L. Sandalwood.

An acetone extract, but not a water extract, of the wood was toxic to mosquito larvae.--Hartzell (89).

A proprietary dressing containing sandalwood oil was repellent to the sheep blowfly.--Mackerras and Mackerras (134).

An aqueous extract of an unidentified portion of this plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SAPINDACEAE

ALLOPHYLUS OCCIDENTALIS (Sw.) Radlk.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ALLOPHYLUS RACEMOSUS (L.) Radlk.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BLIGHIA SAPIDA Kon.

An aqueous extract of the branchlets, leaves, and bark was nontoxic to German and American cockroaches and milkweed bugs. An aqueous extract of the branchlets and leaves alone was nontoxic to both species of cockroaches.--Heal and coworkers (93).

CARDIOSPERMUM GRANDIFLORUM Sw.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CARDIOSPERMUM HALICACABUM L.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CUPANIA TRIQUETA A. Rich.

The wood is very susceptible to termites.--Wolcott (225).

DODONAEA VISCOSA Jacq. Hopbush.

The powdered leaves were nontoxic to cross-striped cabbageworms, Hawaiian beet webworms, and southern armyworms.--Bottger and Jacobson (36).

The powdered leaves were nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to German cockroaches and codling moth larvae.--Jacobson (108).

DODONAEA VISCOSA var. ANGUSTIFOLIA (L.f.) Benth.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

HARPULLIA ARBOREA (Blanco) Radlk.

An aqueous extract of the bark was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol and petroleum ether extracts of the bark were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

KOELREUTERIA PANICULATA Laxm. Koelreuteria.

An acetone extract, but not a water extract, of the seeds and leaves was toxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the branchlets was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

KOELREUTERIA PANICULATA var. APICULATA (Rehd. & Wils.) Rehd.

Acetone and water extracts of the seeds were nontoxic to mosquito larvae.--Hartzell (89).

MAGONIA PUBESCENS A. St. Hil.

Saponins of this plant had no effect on Culex fatigans larvae.--Wasicky and coworkers (219).

An aqueous extract of the bark was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PAULLINIA FUSCESCENS H. B. K.

Some of the plant parts were toxic, as dusts or extracts, to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

PAULLINIA PINNATA L. Barbasco.

An acetone extract of the roots was nontoxic to mosquito larvae.--Jacobson (108).

An aqueous extract of the branches was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PAULLINIA TOMENTOSA Jacq.

An aqueous extract of the branches was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PHIALODISCUS UNIJUGATUS Radlk.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SAPINDUS DRUMMONDII Hook. & Arn.

Aqueous extracts of the bark, of the branchlets and leaves, and of the roots were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SAPINDUS SAPONARIA L.

The crushed dried fruit pulp was ineffective against mosquito larvae.--Flock and de Lajudie (64).

An infusion of the bark is used in El Salvador as a contact poison.--Wellman and van Severen (221).

Extracts of the seeds or fruits were highly toxic to mosquito larvae.--Sievers and coworkers (197).

SAPINDUS sp.

The powdered leaves, bark, wood, and roots each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

SERJANIA GLABRATA H. B. K.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

SERJANIA MEXICANA Willd. Quamecatl.

An acetone extract of the plant was ineffective against mosquito larvae.--Jacobson (108).

SERJANIA PAUCIDENTATA DC. Tingui de folha.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An acetone extract of the aerial portion was ineffective against mosquito larvae.--Jacobson (108).

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SERJANIA RHOMBEA Radlk.

The plant was nontoxic to houseflies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

SERJANIA SCATENS Radlk.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

SERJANIA sp.

An aqueous extract of the branches was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. An aqueous extract of the stems was slightly toxic, and an extract of the stems and tops was nontoxic to American cockroaches.--Heal and coworkers (93).

TALISIA FURFURACEA Sandw.

An aqueous extract of the bark was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

TALISIA SQUARROSA Radlk.

An aqueous extract of the bark was very toxic to American cockroaches but not to German cockroaches. Alcohol and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* mosquito. A petroleum ether extract was nontoxic to all these insects.--Heal and coworkers (93).

UNGNADIA SPECIOSA Endl.

An aqueous extract of the branchlets, leaves, and fruits was nontoxic to American cockroaches.--Heal and coworkers (93).

XANTHOCERAS SORBIFOLIA Bunge.

An aqueous extract of the branchlets and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SAPOTACEAE

ACHRAS ZAPOTA L.

Alcohol, petroleum ether, and chloroform extracts of the inner stem bark were

nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

CHRYSOPHYLLUM CAINITO L.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

LUCUMA MULTIFLORA A. DC.

The wood is susceptible to termites.--Wolcott (225).

MADHUCA LATIFOLIA (Roxb.) Macbr. Synonym: *Bassia latifolia*. Mahua, mowrah.

A saponin obtained from the alcohol extract of this plant was nontoxic to codling moth larvae, melonworms, Colorado potato beetles, southern armyworms, and cross-striped cabbageworms.--Jacobson (108).

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MANILKARA EXCELSA (Ducke) Standl. Massaranduba.

MANILKARA NITIDA (Sesse & Moc.) Dubard. Bulletwood.

The former is much more resistant to termite attack than the latter.--Wolcott (224).

MICROPHOLIS CURVATA.

The wood is susceptible to termites.--Wolcott (225).

PALAQUIUM sp.

The powdered seeds showed considerable toxicity to silkworm larvae and fair toxicity to Mexican bean beetle larvae but no toxicity to bean aphids. An alcohol extract of the seeds had no effect on silkworm larvae and the alcohol, chloroform, acetone, petroleum ether, and carbon tetrachloride extracts had no effect on bean aphids.--Lee and Hansberry (129).

The powdered seeds were nontoxic to bean aphids.--Chiu and coworkers (48).

POUTERIA DEMERARAE Sandw.

The wood is susceptible to termites.--Wolcott (225).

SARRACENIACEAE

DARLINGTONIA CALIFORNICA Torr.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

SARRACENIA PURPUREA L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SAURURACEAE

ANEMOPSIS CALIFORNICA Hook. & Arn.

An aqueous extract of the leaves was slightly toxic to American cockroaches.--Heal and coworkers (93).

SAURURUS CERNUUS L.

An aqueous extract of one sample of the whole plant was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs, but an extract of another sample of whole plant was nontoxic to all these insects.--Heal and coworkers (93).

SAXIFRAGACEAE

ASTILBE sp.

An acetone extract of the whole plant was toxic to mosquito larvae.--Hartzell (90).

CHRYSOSPLENIUM FLAGELLIFERUM F. Schmidt.

Aqueous suspensions of the leaves, stems, and roots were toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

CHRYSOSPLENIUM GLECHOMAEFOLIUM Nutt.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHRYSOSPLENIUM YESOENSE Franch. & Savat.

Aqueous suspensions of the leaves, stems, and roots were toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

ESCALLONIA PULVERULENTA Pers.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

FENDLERA RUPICOLA A. Gray.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

FORGESIA BORBONICA (Lam.) Pers.

Aqueous extracts of the branchlets and leaves and of the stems were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

FRANCOA SONCHIFOLIA Cav.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

HYDRANGEA ARBORESCENS L.

An aqueous extract of the roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ITEA VIRGINICA.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

JAMESIA AMERICANA Torr. & Gray.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

JEPSONIA PARRYI (Torr.) Small.

An aqueous extract of the corms was very toxic to American cockroaches and milkweed bugs but nontoxic to German cockroaches.--Heal and coworkers (93).

LITHOPHRAGMA AFFINIS A. Gray.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PARNASSIA ASARIFOLIA Vent.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PHILADELPHUS LEWISII Pursh.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RIBES CEREUM Dougl.

An aqueous extract of the roots was toxic to German cockroaches, slightly toxic to

American cockroaches, and nontoxic to milkweed bugs.--Heal and coworkers (93).

RIBES GLANDULOSUM Grauer. Skunk currant, mountain currant.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

RIBES NIGRUM L.

The powdered plant was nontoxic to Ixodes and Dermacentor ticks, bedbugs, house flies, Aedes and Anopheles mosquitoes, and Drosophila.--Olenev (163).

SAXIFRAGA AUSTROMONTANA Wiegand.

An aqueous extract of the whole plant was toxic to German and American cockroaches but not to milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

TIARELLA TRIFOLIATA L.

WHIPPLEA MODESTA Torr.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SCROPHULARIACEAE

BACOPA MONNIERI (L.) Pennell.

An aqueous extract of the whole plant was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

BACOPA ROTUNDIFOLIA (Michx.) Wettst.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BARTSIA STRICTA Benth.

BARTSIA VISCOSA L.

Aqueous extracts of the whole plant were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BESSEYA RUBRA (Dougl.) Rydb.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BEYRICHIA OCYMOIDES Cham. & Schlecht.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

BUCHNERA AMERICANA L.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BUCHNERA FLORIDANA Gand.

CAPRARIA BIFLORA L.

Aqueous extracts of the whole plant were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

CASTILLEJA FISSIFOLIA L. f.

CASTILLEJA LINARIAEFOLIA Benth.

CASTILLEJA LINDHEIMERI A. Gray.

CASTILLEJA MINIATA Dougl.

Aqueous extracts of the whole plant were nontoxic to American and German cockroaches and milkweed bugs.--Heal and coworkers (93).

CHELONE GLABRA L. Balmony.

An acetone extract of the leaves was ineffective against mosquito larvae.--Hartzell (90).

Aqueous extracts of fragments of the plant were toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

COLLINSIA TINCTORIA Hartw.

An aqueous extract of the stems, leaves, and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CORDYLANTHUS RAMOSUS Nutt.

An aqueous extract of the whole plant was toxic to American cockroaches, but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ESCOBEDIA SCABRIFOLIA Ruiz & Pavon.

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

EUPHRASIA CANADENSIS Towns.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

EUPHRASIA DISJUNCTA Fern. & Wieg.

An aqueous extract of the whole plant was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

GERARDIA AURICULATA Michx.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GERARDIA FLAVA L. Synonym: Aureolaria flava.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GERARDIA PAUPERCULA (A. Gray) Britton. Synonym: Agalinis paupercula.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GERARDIA PEDICULARIA L. Synonym: Aureolaria pedicularia.

Aqueous extracts of the branchlets, leaves, and flowers, of the stems and leaves, and of the roots were nontoxic to German and American cockroaches and milkweed bugs. Extracts of the tops, leaves, and fruits were slightly toxic to American cockroaches only.--Heal and coworkers (93).

GRATIOLA NEGLECTA Torr.

An aqueous extract of the whole plant with fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ILYSANTHES ANTIPODA (L.) Merr.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LAMOUROUXIA VIRGATA H. B. K.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LINARIA VULGARIS Hill. Butter-and-eggs.

Acetone and water extracts of the flowers and leaves were nontoxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches.--Heal and coworkers (93).

MAURANDYA ANTIRRHINIFLORA Humb. & Bonpl.

The powdered plant was toxic to silkworm larvae but not to larvae of the

Mexican bean beetle and Colorado potato beetle.--Hansberry and Clausen (86).

MELAMPYRUM LINEARE Desr.

An aqueous extract of the whole plant with fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MIMULUS LONGIFLORUS (Nutt.) Grant.

Aqueous extracts of the whole plant and of the upper parts were nontoxic to German and American cockroaches.--Heal and coworkers (93).

MIMULUS RINGENS L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

MIMULUS sp. Mimulus.

Acetone and water extracts of the leaves and stems were ineffective against mosquito larvae.--Hartzell (89).

MOHAVEA CONFERTIFLORA (Benth.) Heller.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ORTHOCARPUS LUTEUS Nutt.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. A chloroform extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and Aedes mosquito larvae. An alcohol extract was nontoxic to all these insects and to Anopheles mosquito larvae.--Heal and coworkers (93).

ORTHOCARPUS PURPURASCENS Benth.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PEDICULARIS GROENLANDICA Retz.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PEDICULARIS LANCEOLATA Michx.

An aqueous extract of the upper parts was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PEDICULARIS PAYSONIANA Pennell.

An aqueous extract of the whole plant was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PENSTEMON GRACILIS Nutt.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RHINANTHUS CRISTA-GALLI L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Anopheles mosquito. Alcohol and chloroform extracts were nontoxic to all these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

SCOPARIA DULCIS L.

A brush made from the plant is used in El Salvador to eliminate lice from chicken houses.--Wellman and van Severen (221).

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SCROPHULARIA LANCEOLATA Pursh.

An aqueous extract of the tops and flowers was toxic to American cockroaches when injected into the blood stream, but German

cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

SCROPHULARIA MARILANDICA L.

An aqueous extract of the upper parts and fruits was highly toxic to German cockroaches. A petroleum ether extract of the stems, leaves, and flowers was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and chloroform extracts were nontoxic to all these insects.--Heal and coworkers (93).

SCROPHULARIA NODOSA L.

An aqueous extract of an unidentified portion was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SEYMERIA CASSIOIDES (Walt.) Blake.
Synonym: Afzelia cassioides.

An aqueous extract of the stems and eaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

ILVIA ITAUBA (Meissn.) Ducke.

The wood is resistant to termites.--Volcott (225).

TEMODIA PUSILLA Benth.

An aqueous extract of the whole plant was ontoxic to German and American cockoaches and milkweed bugs.--Heal and oworkers (93).

ONELLA FLORIBUNDA A. Gray.

An aqueous extract of the whole plant as nontoxic to German and American ockroaches and milkweed bugs.--Heal and oworkers (93).

ANDELLIA DIFFUSA L.

An aqueous extract of the whole plant s slightly toxic to American cockroaches d nontoxic to German cockroaches and lkweed bugs.--Heal and coworkers (93).

VERBASCUM BLATTARIA L.

An aqueous extract of the tops and flowers was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts of the tops and leaves were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

VERBASCUM LYCHNITIS L.

An aqueous extract of the tops and fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

VERBASCUM THAPSUS L. Mullein.

Acetone and water extracts of the leaves were ineffective against mosquito larvae.--Hartzell (89).

VERBASCUM sp.

Acetone and water extracts of the flowers of V. phlomoides or V. thapsiforme were ineffective against mosquito larvae.--Hartzell (89).

VERONICA AMERICANA Schwein.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

VERONICASTRUM VIRGINICUM (L.) Farwell.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches.--Heal and coworkers (93).

SIMAROUBACEAE

AILANTHUS ALTISSIMA (Mill.) Swingle.

An aqueous extract of the branch wood was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BALANITES AEGYPTIACA Delile. Desert date.

The pulp of the ripe fruit was toxic to melonworm and diamondback moth larvae but not to cotton stainer and bean leaf beetle adults and Australian cockroach nymphs. The powdered seeds, leaves, bark, and roots each showed some toxicity to melonworm larvae but were nontoxic to the other insect species mentioned, as were the powdered twigs, spines, and wood.--Plank (174).

Aqueous extracts of the fruits, roots, and seeds were highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. An aqueous extract of the bark and stems was nontoxic to all these insects. Alcohol, petroleum ether, and chloroform extracts of the roots, the seeds, and the fruits were all toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* mosquito. Petroleum ether and chloroform extracts of the bark were toxic to black carpet beetle larvae only, and an alcohol extract of the bark was nontoxic to German cockroaches, milkweed bugs, confused flour beetles, and *Aedes* mosquito larvae.--Heal and coworkers (93).

BALANITES ROXBURGHII Planch.

An aqueous extract of the bark was toxic to American cockroaches and milkweed bugs but not to German cockroaches.--Heal and coworkers (93).

BALANITES WILSONIANA Dawe & Sprague.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. An extract of the bark, roots, and stems was nontoxic to all these insects.--Heal and coworkers (93).

BRUNELLIA COMOCLADIFOLIA Humb. & Bonpl.

Aqueous extracts of the branches and leaves, of the bark, and of the roots were all nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CASTELA TORTUOSA Liebm.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches. Alcohol and chloroform extracts of the roots were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

HANNOA UNDULATA Planch.

Aqueous extracts of the roots and of the fruits were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PICRAMNIA PENTANDRA Sw.

The plant is used as a general insecticide in Haiti.--Higbee (94).

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PICROLEMMA PSEUDOCOFFEA Ducke.

An aqueous extract of the leaves was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts of the stems and roots were toxic to black carpet beetle larvae (the chloroform extract was also toxic to webbing clothes moth larvae), and nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes. Chloroform extracts of the roots and of the stems were toxic to webbing clothes moth, black carpet beetle, and *Aedes* mosquito larvae, but not to the other insects.--Heal and coworkers (93).

PICROLEMMA SPRUCEI Hook. f.

Chloroform extracts of the branches and leaves and of the roots were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes.--Heal and coworkers (93).

QUASSIA AMARA L. Surinam quassia, West Indian quassia.

Boxes made of the wood are used for the storage of clothing to protect it from moths. Fly paper can be made of blotting

paper soaked in a sugared extract of the wood.--Higbee (94).

The bitter principle, quassin, showed little, if any, toxicity to green peach aphids, house flies, and Mexican bean beetles. Second instars of the bean beetle were susceptible, but adults and fourth instars were much more resistant. It was also nontoxic to American cockroaches.--McGovran and coworkers (144).

The powdered roots were highly toxic to melonworm larvae by contact, and moderately to weakly toxic to diamondback moth larvae, cotton stainer and bean leaf beetle adults, and Australian cockroach nymphs. Leaves, bark, and wood were very weakly toxic to these insects.--Plank (174).

A 10-percent emulsion of extracts of the wood, used as a spray, had no effect on Triatoma infestans.--Wasicky and Unti (218).

SAMADERA INDICA Gaertn.

The bark is used as an insecticide in the Philippines.--Quisumbing (179).

Alcohol, petroleum ether, and chloroform extracts of the root wood were toxic to black carpet beetle larvae (the petroleum ether extract was also toxic to milkweed bugs), but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

SIMABA CEDRON Planch.

An aqueous extract of the nut shells was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SIMABA MULTIFLORA A. Juss.

The wood is very susceptible to termites.--Wolcott (225).

SIMARUBA AMARA Aubl. Brazilian white pine.

The wood is very susceptible to termites.--Wolcott (225).

An acetone extract of the bark was ineffective against mosquito larvae.--Hartzell (90).

A 10-percent emulsion of extracts of the bark, used as a spray, had no effect on Triatoma infestans.--Wasicky and Unti (218).

An aqueous extract of the roots was toxic to German cockroaches but not to American cockroaches. Alcohol and chloroform extracts were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

SIMARUBA GLAUCA DC.

An aqueous extract of the branches was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SOLANACEAE

ACNISTUS ARBORESCENS (L.) Schlecht.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches only.--Heal and coworkers (93).

ATROPA BELLADONNA L. Belladonna.

An acetone extract of the leaves was ineffective against mosquito larvae.--Hartzell (90).

BRACHISTUS RHOMBOIDEUS (H. B. K.) Miers. Synonym: Witheringia rhomboidea.

An aqueous extract of the branches and leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

BRUNFELSIA DENSIFOLIA Krug & Urban.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BRUNFELSIA HOPEANA Benth.

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CAPSICUM FRUTESCENS L. Synonym: C. annuum. Cayenne pepper, red pepper.

The ground dried fruits are sprinkled among materials to be preserved in El Salvador.--Wellman and Van Severen (221).

Acetone and water extracts of the fruits were ineffective against mosquito larvae.--Hartzell (89).

An acetone extract of the pods was toxic to mosquito larvae.--Hartzell (90).

CAPSICUM sp.

An acetone extract of the fruits was toxic to mosquito larvae.--Hartzell (90).

A composition containing capsicum, sabadilla seeds, and an activator is effective against Dysdercus, Aphis, roaches, lice, and fleas.--Babbini (29).

CESTRUM DIURNUM L.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CESTRUM LATIFOLIUM var. TENUIFLORUM (H. B. K.) O. E. Schulz.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

CESTRUM PARQUI L'Hérit.

An aqueous extract of the stems and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

CHAMAESARACHA NANA A. Gray.

An aqueous extract of the whole plant was toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DATURA ARBOREA L.

The plant is used in Cuba to repel giant ants.--Higbee (94).

DATURA CANDIDA (Pers.) Safford.

Some of the plant parts, as dusts or extracts, were toxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

DATURA FEROX L.

An aqueous extract of the seeds was nontoxic to German and American cockroaches.--Heal and coworkers (93).

DATURA METELOIDES DC.

The powdered plant was nontoxic to southern beet webworms and European corn borers. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were ineffective against house flies and codling moths.--Jacobson (108).

DATURA STRAMONIUM L.

An acetone extract of the leaves was nontoxic to mosquito larvae.--Hartzell (90).

FABIANA IMBRICATA Ruiz & Pavon.

An aqueous extract of fragments of the plant was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

JABOROSA RUNCINATA Lam.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

LATUA PUBIFLORA (Griseb.) Baill.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LYCIUM HALIMIFOLIUM Mill.

An aqueous extract of the whole plant was toxic to German cockroaches but not to American cockroaches.--Heal and coworkers (93).

LYCOPERSICON ESCULENTUM Mill. Synonym: Solanum lycopersicon. Tomato.

The powdered stems and leaves were nontoxic to diamondback moth larvae. Acetone extracts of the roots, stems, and leaves were all ineffective against adult potato aphids and saw-toothed grain beetles.

The stems and leaves, macerated with water, had no effect on potato aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

Petroleum ether, ethyl ether, and alcohol extracts were all nontoxic to house flies, although the alcohol extract was toxic to German cockroaches.--Jacobson (108).

LYCOPERSICON ESCULENTUM var. PRUNIFORME

LYCOPERSICON HIRSUTUM Humb. & Bonpl.

LYCOPERSICON PERUVIANUM var. CHUTATUM

LYCOPERSICON PERUVIANUM var. PUTATUM

LYCOPERSICON PERUVIANUM var. X

LYCOPERSICON PIMPINELLIFOLIUM (Jusl.) Mill.

Potato leaves which had been infiltrated with an aqueous solution of tomatin, obtained from the leaves of these species of tomatoes, completely repelled potato beetle larvae when the tomatin concentration in the potato leaf was 0.5 percent.--Kuhn and coworkers (121).

An aqueous extract of the stems and leaves of *L. peruvianum* was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

NICANDRA PHYSALODES (L.) Gaertn. Apple-of-Peru.

Petroleum ether, ethyl ether, and chloroform extracts of the whole plant were nontoxic to house flies.--Jacobson (108).

Aqueous extracts of the whole plant and of the upper parts and fruits were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

NIEREMBERGIA HIPPOMANICA Miers.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PETUNIA HYBRIDA Vilm.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream.--Heal and coworkers (93).

PHYSALIS MOLLIS Nutt. Smooth groundcherry.

This plant has been used for years as a fly poison in Oklahoma. Both the powdered leaves and a glycoside isolated from the alcohol extractive were toxic to house flies. An alkaloid isolated from the chloroform extract of the leaves was nontoxic to house flies in small dosage.--Harris (88).

Petroleum ether, ethyl ether, and chloroform extracts of the fruits from Texas were all nontoxic to house flies.--Jacobson (108).

SALPICHROA ORIGANIFOLIA (Lam.) Thell.

SCHWENKIA AMERICANA L.

Aqueous extracts of the whole plants were slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SOLANDRA LONGIFLORA Tussac.

An aqueous extract of the branches and leaves was nontoxic to German cockroaches and slightly toxic to American cockroaches.--Heal and coworkers (93).

SOLANUM BALLSII Hawkes.

Of many wild species of *Solanum* tested, only the tubers of this species were resistant to the golden nematode.--Ellenby (58).

SOLANUM CHACOENSE Bitter. Wild potato.

Tests with the leaves, leaf sandwiches, and the press juice showed that the leaves are less attractive to the potato beetle than those of *S. tuberosum* because they contain a repellent substance.--Langenbuch (127).

SOLANUM CILIATUM Lam.

The powdered immature and ripe fruits showed little or no toxicity to melonworm and diamondback moth larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs. The ripe fruits were nontoxic to *Diabrotica bivittata* adults and American cockroach nymphs. The powdered leaves and stems each showed little

or not toxicity to melonworm and diamond-back moth larvae, Diabrotica bivittata and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

SOLANUM CRISPUM var. LIGUSTRINUM (Lodd.) Dunal.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SOLANUM DEMISSUM Lindl. Wild potato.

The resistance of this plant to potato beetle larvae was attributed to the alkaloid, demissine, isolated from its leaves. A 5-percent aqueous solution of demissine strongly inhibited growth and development of the insect.--Kuhn and Gauhe (119).

Demissine, isolated in 0.10-0.47-percent yield from the leaves, strongly repelled potato beetle larvae.--Kuhn and Löw (120).

Larvae of all instars of the potato beetle were confined to the leaves of 14 strains of this plant. It was concluded that the resistance is due merely to some factor that renders the leaves unpalatable to the larvae, rather than to a toxic principle.--de Wilde (223).

SOLANUM GLAUCUM Dunal.

An aqueous extract of the roots and stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SOLANUM GUANICENSE Urban.

An aqueous extract of the stems and fruits was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SOLANUM LEUCOCARPON Dunal.

The plant was nontoxic to house flies, mosquito larvae, and several species of leaf-eating larvae.--Sievers and coworkers (197).

SOLANUM MALACOXYLON Sendt.

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

SOLANUM MAMMOSUM L. Love apple.

The leaves were highly toxic to mosquito larvae.--Sievers and coworkers (197).

The powdered ripe fruits, leaves, stems, and roots each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs, although the plant is reported to be useful in the control of cockroaches.--Plank (174).

SOLANUM NIGRUM L.

The powdered ripe fruits, leaves, small branches, and woody stems each showed little or no toxicity to melonworm larvae, bean leaf beetle and cotton stainer adults, and Australian cockroach nymphs.--Plank (174).

An aqueous extract of the leaves was very toxic to German and American cockroaches.--Heal and coworkers (93).

SOLANUM PAMPASENSE Hawkes.

Of 40 wild species of Solanum tested, the tubers of only this species were resistant to golden nematodes.--Ellenby (57).

SOLANUM POLYADENIUM Greenm.

Wild plants showed almost complete immunity to attack by the aphids that infest potatoes in New Brunswick, Canada.--Gardiner (69).

Aphids (Myzus persicae) placed on the plants did not feed and their movements were impeded by a black gummy substance. The leaves bear numerous glandular hairs, and tests demonstrated the presence of a free oily substance on the leaf surface. It is suggested that the immunity of mature leaves from aphid attack is due to a repellent action of the free oil and the mechanical action of the gummy secretion in preventing the aphids from feeding.--Stringer (202).

SOLANUM SUCRENSE Hawkes.

The tubers are resistant to golden nematodes.--Mai and Peterson (135).

SOLANUM TORREYI A. Gray. Purple nightshade.

The powdered plant was nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were nontoxic to

house flies and codling moth larvae.--Jacobson (108).

SOLANUM TRIFLORUM Nutt.

An aqueous extract of the whole plant with fruits was toxic to German and American cockroaches but not to milkweed bugs.--Heal and coworkers (93).

SOLANUM TUBEROSUM L. Potato.

An acetone extract of the sprouts was ineffective against mosquito larvae.--Hartzell (90).

The alkaloid Solanine T. present in the leaves, was inactive against potato beetle larvae.--Kuhn and Gauhe (119).

SOLANUM VERBASCIFOLIUM L.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SOLANUM sp.

Two specimens of the Commersoniana group of wild potatoes, resistant to the Colorado potato beetle, contained predominantly solanine-type, rather than demissine-type, products.--Prokoshev and Petrochenko (178).

An aqueous extract of the fruits was nontoxic to German and American cockroaches.--Heal and coworkers (93).

WITHANIA SOMNIFERA (L.) Dunal.

An aqueous extract of the roots was nontoxic to German and American cockroaches.--Heal and coworkers (93).

SPARGANIACEAE

SPARGANIUM EURYCARPUM Engelm.

An aqueous extract of the whole plant with fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

STAPHYLEACEAE

STAPHYLEA TRIFOLIA L.

An aqueous extract of the seeds and roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TURPINIA PANICULATA Vent.

The wood is resistant to termites.--Wolcott (225).

An aqueous extract of the roots was toxic to American cockroaches when injected into the blood stream but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the branchlets and leaves was nontoxic to all these insects.--Heal and coworkers (93).

STEMONACEAE

CROOMIA PAUCIFLORA Torr.

An aqueous extract of the whole plant was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

STEMONA JAPONICA Franch. & Savat.

An acetone extract of the roots was toxic to Culex pipiens larvae. The toxicity was traced to the basic portion of the extract.--Yamaguchi and coworkers (232).

STEMONA TUBEROSA Lour. Paipu.

An acetone extract of the roots was toxic to tent caterpillars and cotton aphids, and an alcohol extract was toxic to body lice and plant lice. The toxicity is due to the presence of alkaloids.--Chiu (47).

An aqueous extract of the stems and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

STERCULIACEAE

AYENIA BERLANDIERI S. Wats.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

COLA NITIDA (Vent.) Schott. & Endl. Cola.

An acetone extract of the nuts was ineffective against mosquito larvae.--Hartzell (90).

DOMBEYA QUINQUESETA (Delile) Exell.

An aqueous extract of the stem bark was toxic to German and American cockroaches but not to milkweed bugs. An extract of the roots was nontoxic to all these insects.--Heal and coworkers (93).

DOMBEYA ROTUNDIFOLIA Planch.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

FIRMIANA SIMPLEX (L.) W. F. Wright.

An aqueous extract of the branchlets, leaves, and fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GUAZUMA ULMIFOLIA Lam.

The wood is very susceptible to termites.--Wolcott (225).

Aqueous extracts of the branchlets and leaves and of the stems were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. An extract of the bark was slightly toxic to American cockroaches.--Heal and coworkers (93).

HELICTERES JAMAICENSIS Jacq.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

KLEINHOVIA HOSPITA L.

An aqueous extract of the bark was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Petroleum ether and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract was nontoxic to all these insects.--Heal and coworkers (93).

MANSONIA ALTISSIMA A. Chev.

An aqueous extract of the stem wood was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PTEROSPERMUM ACERIFOLIUM Willd.

An aqueous extract of the flowers was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

STERCULIA PRURIENS (Aubl.) K. Schum. Yahu.

The wood is very susceptible to termites.--Wolcott (225).

THEOBROMA CACAO L. Cocoa.

An acetone extract of the shells was ineffective against mosquito larvae.--Hartzell (90).

WALTHERIA AMERICANA L.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

STYRACEAE

HALESIA CAROLINA L.

Aqueous extracts of the roots, the branchlets and leaves, the stem bark, and the twigs were all very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the fruits was slightly toxic to American cockroaches only. A chloroform extract of the roots was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and petroleum ether extracts of the roots were nontoxic to all these insects. A petroleum ether extract of the bark was toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, confused flour beetles, and webbing clothes moth larvae. Alcohol and chloroform extracts of the bark were nontoxic to these insects.--Heal and coworkers (93).

HALESIA sp.

An aqueous extract of the branchlets and leaves was very toxic to American cock-

roaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LISSOCARPA GUIANENSIS Gleason.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

STYRAX AMERICANA Lam.

An aqueous extract of the stem bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

STYRAX BENZOIN Dryand.

Acetone and water extracts of benzoin gum were ineffective against mosquito larvae.--Hartzell (89).

STYRAX JAPONICA Sieb. & Zucc. Ego.

An acetone extract of the fruits was toxic to Culex pipiens larvae. The toxicity was traced to the acidic portion of the extract.--Yamaguchi and coworkers (232).

Ego seed oil, egonol, and egonal, obtained from this plant, were all very effective pyrethrum synergists when tested against Aphis gossypii, A. laburni, Brevicoryne brassicae, Pterochlorus japonicus, and Myzus persicae.--Matsubara (137, 139).

SYMPLOCACEAE

SYMPLOCOS TINCTORIA L'Hérit. Sweetleaf, wild laurel.

An acetone extract of the stems showed some toxicity to mosquito larvae.--Jacobson (108).

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

TAMARICACEAE

TAMARIX APHYLLA (L.) Karst.

TAMARIX GALLICA L.

Aqueous extracts of the branches were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TAXACEAE

CEPHALOTAXUS DRUPACEA Sieb. & Zucc.

A water suspension of the leaves and stems was very toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

DACRYDIUM FRANKLINII. Synonym: D. Huonense. Huon pine.

Huon pine oil was very effective as a repellent to Aedes and Anopheles mosquitoes and was also toxic to these insects. Its activity is due to its high methyl eugenol content. The oil repels March flies, sand flies, and sheep blowflies, but not bush flies.--McCulloch and Waterhouse (142).

The essential oil is highly repellent to Australian sheep blowflies.--Waterhouse (220).

The oil prevents blowflies from laying their eggs on sheep.--Anonymous (21).

The wood essential oil was a very effective synergist with pyrenthrins against house flies, although it gave no mortality or knockdown when used alone. The action of methyl eugenol, its chief component, was considerable, but less than that of the oil. After removal of all the methyl eugenol by distillation, the residue was as effective a synergist as the distillate.--Kerr (114).

TAXUS BACCATA var. REPANDENS Parsons.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

TAXUS CUSPIDATA Sieb. & Zucc. var. AMBRACULIFERA.

A water suspension of the flowers was nontoxic to Drosophila hydei larvae, but a suspension of the leaves and stems was very toxic to these larvae.--Yamaguchi and coworkers (233).

TAXUS FLORIDANA.

An aqueous extract of the wood was nontoxic to German and American cockroaches.--Heal and coworkers (93).

TORREYA TAXIFOLIA Arn.

An aqueous extract of the wood was nontoxic to German and American cockroaches

and milkweed bugs.--Heal and coworkers (93).

TAXODIACEAE

TAIWANIA CRYPTOMERIOIDES Hayata.

Caryophyllene, present in the wood, offers little protection against termite attack at low concentration, but 5-percent caryophyllene did prevent termites from eating treated wood for almost four weeks.--Wolcott (224).

TERMINALIACEAE

BUCIDA BUCERAS L. Black olive.

The wood is resistant to termites.--Wolcott (225).

CONOCARPUS ERECTUS L. Buttonwood.

The wood is susceptible to termites.--Wolcott (225).

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches. An alcohol extract of the bark was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito.--Heal and coworkers (93).

THEACEAE

CAMELLIA JAPONICA L. Camellia.

An acetone extract of the leaves was toxic to mosquito larvae.--Hartzell (90).

An aqueous extract of the leaves was toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

CAMELLIA SINENSIS (L.) Kuntze. Synonym: Thea sinensis. Tea.

Tea seed oil soap was highly toxic to sugarcane wooly aphids.--Cheu (45).

In field experiments in Kwangsi, a spray of 0.5 percent tea seed oil soap applied to sugarcane infested with the wooley aphis gave average mortalities of 93.4-99.9 percent.--Cheu (47).

Fat-extracted tea seed meal is cooked in an autoclave to decompose the lipids, calcium hydroxide is added, and the mixture is ground to a powder. The preparation is an effective vermicide for the rice seedling bed.--Naramoto (159).

GORDONIA LASIANTHUS L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An alcohol extract of the branchlets and leaves was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Petroleum ether and chloroform extracts of the branchlets and leaves were nontoxic to all these insects.--Heal and coworkers (93).

SCHIMA WALLICHII Choisy.

An aqueous extract of the bark was nontoxic to German and American cockroaches. An alcohol extract of the wood was nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes mosquito.--Heal and coworkers (93).

VISNEA MOCANERA L. f.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

THEOPHRASTACEAE

CLAVIJA LANCIFOLIA Desf.

Aqueous extracts of the stems and of the roots were toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts.--Heal and coworkers (93).

DEHERAINIA CUBENSIS (Radlk.) Mez.

An aqueous extract of the roots was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. An extract of the stems and leaves was slightly toxic to American cockroaches only.--Heal and coworkers (93).

JACQUINIA ACULEATA.

Aqueous extracts of the roots and of the branches and leaves were toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

JACQUINIA ARISTATA Jacq.

The powdered roots were highly toxic to melonworm and diamondback moth larvae but weakly toxic or inert to cotton stainer and bean leaf beetle adults and Australian cockroach nymphs. The leaves, bark, and wood were very weakly toxic to these insects.--Plank (174).

JACQUINIA AURANTIACA Ait.

Aqueous extracts of the bark and of the wood were very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extracts. Alcohol and petroleum ether extracts of the wood were toxic to black carpet beetle larvae (the petroleum ether extract was also toxic to milkweed bugs), but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* mosquito. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

JACQUINIA BARBASCO (Loefl.) Mez.

Aqueous extracts of the leaves, the roots, and the branchlets were toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

JACQUINIA KEYENSIS Mez.

An aqueous extract of the roots was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. An extract of the branches and leaves was slightly toxic to American cockroaches only.--Heal and coworkers (93).

JACQUINIA PUNGENS A. Gray.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches.--Heal and coworkers (93).

JACQUINIA sp.

An acetone extract was nontoxic to mosquito larvae. Combined petroleum ether, ethyl ether, and chloroform extractives, and an alcohol extractive of the seeds of a species of *Jacquinia* known as "barbasco ca" were ineffective against codling moth larvae and house flies.--Jacobson (108).

THEOPHRASTA JUSSIAEI Lindl.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coaorkers (93).

THYMELIACEAE

AQUILARIA AGALLOCHA

An aqueous extract of the wood was nontoxic to German and American cockroaches. A petroleum ether extract was nontoxic to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth, black carpet beetle, and *Aedes* mosquito.--Heal and coworkers (93).

DAPHNE CNEORUM L.

An aqueous extract of the whole plant was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and *Aedes* mosquito.--Heal and coworkers (93).

DAPHNE MEZEREUM L. Mezereon.

An acetone extract of the bark was ineffective against mosquito larvae.--Hartzell (90).

The powdered plant was nontoxic to *Ixodes* and *Dermacentor* ticks, bedbugs, house flies, *Aedes* and *Anopheles* mosquitoes, and *Drosophila*.--Olenev (163).

An aqueous extract of the fruits, but not of the roots, was toxic to American cockroaches and milkweed bugs, and both were nontoxic to German cockroaches.--Heal and coworkers (93).

DAPHNE PSEUDO-MEZEREUM A. Gray.

A water suspension of the leaves was nontoxic to *Drosophila hydei* larvae, but a suspension of the roots was toxic to the larvae.--Yamaguchi and coworkers (233).

DAPHNOPSIS BOGOTENSIS Meissn.

Aqueous extracts of the bark, the branchlets, the branchlets and leaves, and the roots were all toxic to American cockroaches but not to German cockroaches

and milkweed bugs.--Heal and coworkers (93).

DAPHNOPSIS CARIBAEA Griseb.

Aqueous extracts of the roots and of the stems were toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DAPHNOPSIS ESPINOSAE Monachino.

Aqueous extracts of the roots and of the stem bark were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DAPHNOPSIS RACEMOSA Griseb.

An aqueous extract of the branches and leaves was very toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DIRCA OCCIDENTALIS A. Gray.

An aqueous extract of the branches was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

DIRCA PALUSTRIS L.

An aqueous extract of the bark was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

EDGEWORTHIA GARDNERI Meissn.

An aqueous extract of the branches, leaves, and bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

FUNIFERA UTILIS Leandr.

An aqueous extract of the branches and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HYPTIODAPHNE CRASSIFOLIA (Poir.) Urban.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs. An extract of the roots was slightly toxic to American cockroaches only.--Heal and coworkers (93).

LASIOSIPHON BURCHELLII Meissn.

An aqueous extract of the leaves and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

OVIDIA PILLO-PILLO Meissn.

An aqueous extract of the leaves was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the roots was slightly toxic to American cockroaches only. Petroleum ether and chloroform extracts of the leaves were toxic to carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. An alcohol extract of the leaves was nontoxic to all these insects.--Heal and coworkers (93).

STELLERA CHAEMEJASME L. Lang-tu.

An alcohol extract of the rootstocks was repellent and toxic to tent caterpillars but nontoxic to American cockroaches, confused flour beetles, rice weevils, and cotton aphids. Crystals obtained from a petroleum ether extract of the rootstocks were nontoxic to tent caterpillars, but the noncrystalline portion was repellent and toxic to these caterpillars.-- Chiu (47).

WIKSTROEMIA INDICA (L.) C. A. Mey.

The powdered roots were nontoxic to bean aphids.--Chiu and coworkers (48).

WIKSTROEMIA NUTANS Champ.

The plant is used as an insecticide in China. The powdered roots showed little toxicity to silkworm and Mexican bean beetle larvae and bean aphids.--Lee and Hansberry (129).

WIKSTROEMIA SANDWICENSIS Meissn.

Aqueous extracts of the leaves, the roots, and the stems were all slightly toxic to American cockroaches. Alcohol and petroleum ether extracts of an unidentified part

of the plant were toxic to black carpet beetle larvae (the petroleum ether extract was also toxic to webbing clothes moth larvae), but not to German cockroaches, milkweed bugs, and *Aedes* and *Anopheles* mosquito larvae.--Heal and coworkers (93).

TILIACEAE

GREWIA ASIATICA L.

An aqueous extract of the stem bark was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

LUEHEA DIVARICATA Mart.

An aqueous extract of the leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SLOANEA BERTERIANA Choisy.

The wood is susceptible to termites.--Wolcott (225).

TRIUMFETTA sp.

Aqueous extracts of the roots and of the stems were toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TROCHODENDRACEAE

EUPTELEA POLYANDRA Sieb. & Zucc.

An aqueous extract of the branches and eaves was toxic to American cockroaches, ut not to German cockroaches and milkveed bugs.--Heal and coworkers (93).

TROPAEOLACEAE

ROPAEOLUM MAJUS L. Nasturtium.

Acetone and water extracts of the leaves nd stems were nontoxic to mosquito arvae.--Hartzell (89).

An aqueous extract of the stems was ontoxic to German and American cockoaches and milkweed bugs. A petroleum her extract of the stems and leaves was xic to black carpet beetle larvae, but ot to German cockroaches, milkweed bugs, d webbing clothes moth larvae. Alcohol d chloroform extracts were nontoxic to these insects as well as to *Aedes* and *Anopheles* mosquito larvae.--Heal and coworkers (93).

TURNERACEAE

PIRIQUETA CAROLINIANA (Walt.) Urban.

Aqueous extracts of the whole plant and of the seeds were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PIRIQUETA sp.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

TURNERA DIFFUSA Willd.

An aqueous extract of the branchlets and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TYPHACEAE

TYPHA LATIFOLIA L.

An aqueous extract of the whole plant was toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ULMACEAE

CELTIS PALLIDA Torr.

An aqueous extract of the roots and stems was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHAETACHME ARISTATA Planch.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PHYLLOSTYLON BRASILIENSIS Capan.

An aqueous extract of the wood was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

TREMA AMBOINENSIS (Willd.) Blume. Synonym: T. aspera.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

TREMA FLORIDANA Britton.

An aqueous extract of the branches and leaves was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

UMBELLIFERAE

AMMI VISNAGA (L.) Lam.

An aqueous extract of the tops and fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ANETHUM GRAVEOLENS L. Dill.

Acetone and water extracts of the stems and leaves were ineffective against mosquito larvae.--Hartzell (89).

ANGELICA ATROPURPUREA L.

An aqueous extract of the tops and flowers was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

ANGELICA POLYMORPHA Maxim.

Water suspensions of the roots and of the leaves and stems were nontoxic to Drosophila hydei larvae, but a suspension of the seeds was toxic to these larvae.--Yamaguchi and coworkers (233).

ANTHRISCUS VULGARIS Bernh.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

APIUM GRAVEOLENS L. Celery.

Alcohol, petroleum ether, and chloroform extracts of the seeds were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

ARCTOPUS ECHINATUS L.

An aqueous extract of the whole plant was very toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

AZORELLA LYCOPODIOIDES Gaud.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CARUM CARVI L. Caraway.

Acetone and water extracts of the seeds were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the seeds was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CENTELLA ASIATICA (L.) Urban.

The powdered plant showed fair toxicity to Mexican bean beetle larvae but had no effect on silkworm larvae and bean aphids. Chloroform and acetone extracts had no effect on bean aphids.--Lee and Hansberry (129).

The powdered plant was toxic to bean aphids.--Chiu and coworkers (48).

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CICUTA MACULATA L. Water hemlock, spotted cowbane, wild parsnip.

The powdered tubers were nontoxic to southern armyworms, melonworms, and Hawaiian beet webworms.--Bottger and Jacobson (36).

The powdered tubers were nontoxic to European corn borer larvae. Combined petroleum ether, ethyl ether, and chloroform extractives and an alcohol extractive were nontoxic to house flies, German cockroaches, and codling moth larvae.--Jacobson (108).

An aqueous extract of the stems and flowers was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CONIUM MACULATUM L. Conium.

An acetone extract of the leaves was ineffective against mosquito larvae.--Hartzell (90).

An aqueous extract of the stems was nontoxic to American cockroaches.--Heal and coworkers (93).

CORIANDRUM SATIVUM L. Coriander.

Acetone and water extracts of the seeds were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CUMINUM sp. Cumin.

An acetone extract, but not a water extract, of the seeds was toxic to mosquito larvae.--Hartzell (89).

An aqueous extract of an unidentified part of the plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CYNOMARATHRUM NUTTALLII (A. Gray) Coult. & Rose. Nuttall dogparsley.

An aqueous solution of the resin from the roots was ineffective against mosquito larvae.--Jacobson (108).

DAUCUS CAROTA L. Carrot.

Acetone and water extracts of the seeds were ineffective against mosquito larvae.--Hartzell (89).

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

A glycosidal bitter principle isolated from dried carrot greens showed no anthelmintic action.--von Gizycki and Hermanns (76).

FERULA ASAFOETIDA L. Asafoetida.

An acetone extract of the gum was ineffective against mosquito larvae.--Hartzell (90).

A 20-percent talc dust of the gum was toxic to melonworms but not to southern armyworms and southern beet webworms.--Bottger and Jacobson (36).

A 20-percent talc dust of the gum was ineffective against European corn borer larvae. The gum had no effect on house flies and codling moth larvae.--Jacobson (108).

FOENICULUM VULGARE Mill. Fennel.

An acetone extract, but not a water extract, of the seeds was toxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the whole plant was nontoxic to German and American cockroaches. An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs. Alcohol and chloroform extracts of the seeds were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and *Aedes* and *Anopheles* mosquitoes. A petroleum ether extract of the seeds was nontoxic to all these insects.--Heal and coworkers (93).

HERACLEUM LANATUM Michx.

An aqueous extract of the roots and fruits was nontoxic to German and American cockroaches.--Heal and coworkers (93).

HYDROCOTYLE JAVANICA Thunb. var. LAXA.

A water suspension of the leaves, stems, and roots was toxic to *Drosophila hydei* larvae.--Yamaguchi and coworkers (233).

LEPTOTAENIA MULTIFIDA Nutt.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches.--Heal and coworkers (93).

LEVISTICUM OFFICINALE W. D. J. Koch. Lovage.

Acetone and water extracts of the leaves and stems were ineffective against mosquito larvae.--Hartzell (89).

LIBANOTIS UGOENSIS (Koidz.) Kitagawa.

A water suspension of the leaves and flowers was nontoxic to *Drosophila hydei* larvae, but a suspension of the combined leaves, stems, and roots was highly toxic to the larvae.--Yamaguchi and coworkers (233).

LOMATIUM NUDICAULE (Pursh) Coult. & Rose.

Aqueous extracts of the whole plant and of the fruits were nontoxic to German

and American cockroaches and milkweed bugs.--Heal and coworkers (93).

OENANTHE CROCATA L. Water hemlock.

Alcohol, acetone, or benzene extracts of the roots showed little or no toxicity to adult chrysanthemum aphids and saw-toothed grain beetles.--Tattersfield and coworkers (209).

OENANTHE SARMENTOSA Presl.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

OSMORHIZA ARISTATA (Thunb.) Rydb.

Water suspensions of the roots and of the leaves and stems were toxic to Drosophila hydei larvae, but a suspension of the leaves was nontoxic to the larvae.--Yamaguchi and coworkers (233).

OXYPOLIS RIGIDIOR (L.) Coult. & Rose.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PERIDERIDIA GAIRDNERI (Hook. & Arn.) Mathias.

An aqueous extract of the tops and fruits was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

PETROSELINUM CRISPUM (Mill.) Nim. Synonym: Apium petroselinum. Parsley.

Acetone and water extracts of the leaves and stems were nontoxic to mosquito larvae.--Hartzell (89).

Neither petroleum ether nor alcohol extracts of the seeds showed any toxicity or synergism with pyrethrins in tests against house flies.--Jacobson (108).

Apiol, obtained from parsley seed oil, markedly increased the toxicity of a pyrethrum spray to house flies.--Kerr (114).

An aqueous extract of the seeds was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PETROSELINUM SATIVUM Hoffm.

An aqueous extract of the seeds was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PEUCEDANUM OSTRUTHIUM (L.) Koch. Synonym: Imperatoria ostruthium. Masterwort.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

Alcohol and benzene extracts of the roots showed some toxicity to mosquito larvae.--Jacobson (108).

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PIMPINELLA ANISUM L.

An acetone extract, but not a water extract, of the seeds was toxic to mosquito larvae.--Hartzell (89).

An aqueous extract of the seeds was very toxic to German and American cockroaches and milkweed bugs. A chloroform extract of the seeds was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. Alcohol and petroleum ether extracts were nontoxic to all these insects.--Heal and coworkers (93).

PIMPINELLA DENDROSELINUM Webb & Berth.

An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PIMPINELLA SAXIFRAGA L.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

PIMPINELLA sp.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PRANGOS PABULARIA Lindl.

Hot water extracts of the roots and root bark of this Russian plant were effective

against mites on domestic animals.--Krok and Minin (118).

Hot water extracts of the roots, tested at a dilution of 1 to 4, were completely effective in the treatment of scabies in humans. A dilution of 1 to 9 was ineffective.--Zaglyadina (236).

SIUM SUAVE Walt.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An extract of the above-ground portions was slightly toxic to American cockroaches only.--Heal and coworkers (93).

SPHENOSCIADUM CAPITELLATUM A. Gray var. SCABRUM Jepson.

An aqueous extract of the leaves was toxic to German cockroaches but not to American cockroaches.--Heal and coworkers (93).

URTICACEAE

BOEHMERIA CYLINDRICA (L.) Sw.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CHAETOPTELEA MEXICANA Liebm. Synonym: Ulmus mexicana. Cenizo.

The heartwood of this tree from Panama was moderately resistant to termites.--Scheffer and Duncan (191).

FORSKOHLEA ANGUSTIFOLIA Retz.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

GESNOUINIA ARBOREA (L.) Gaud.

An aqueous extract of the whole plant was very toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HESPEROCNIDE TENELLA Torr.

An aqueous extract of the whole plant was slightly toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LAPORTIA CANADENSIS (L.) Wedd.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

OBETIA PINNATIFIDA Baker.

An aqueous extract of the stems and leaves was nontoxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PELLIONIA SCABRA Benth.

A water suspension of the leaves, stems, and roots was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

PHYLLOSTYLON sp. Melón.

The wood is susceptible to termites.--Wolcott (226).

PILEA MICROPHYLLA Liebm.

PILEA SERPYLLIFOLIA Wedd.

Aqueous extracts of the whole plant were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

PIRATINERA GUIANENSIS Aubl. Synonym: Brosimum aubletii. Letterwood.

The wood is very resistant to termites.--Wolcott (225).

URERA BACCIFERA (L.) Gaud.

An aqueous extract of the stems and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

URTICA BREWERI S. Wats.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Alcohol and petroleum ether extracts were toxic to black carpet beetle larvae but not to German cockroaches,

milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes. A chloroform extract was nontoxic to all these insects.--Heal and coworkers (93).

URTICA CHAMAEDRYOIDES Pursh.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

URTICA DIOICA L. Nettle herb.

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

URTICA PROCERA Muhl.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

VALERIANACEAE

VALERIANA OFFICINALIS L. Valerian.

Acetone and water extracts of the roots were ineffective against mosquito larvae.--Hartzell (89).

VALERIANA SCOULERI Rydb.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

VALERIANOPSIS CHAMAEDRIFOLIA C. A. Muell.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

VERBENACEAE

CALLICARPA AMERICANA L.

An aqueous extract of the stems and leaves was toxic to German cockroaches but not to American cockroaches and milkweed bugs.--Heal and coworkers (93).

CALLICARPA CANA L. Tubang dalag.

An acetone extract of the leaves, stems, and berries was ineffective against mosquito larvae.--Jacobson (108).

An aqueous extract of the leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

CALLICARPA ERIOCLONA Schauer.

An aqueous extract of the leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract.--Heal and coworkers (93).

CITHAREXYLUM FRUTICOSUM L. Old woman's bitter.

The wood is susceptible to termites.--Wolcott (225).

CITHAREXYLUM FRUTICOSUM var. BRITTONII Moldenke.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CLERODENDRUM HETEROPHYLLUM Ait.

An aqueous extract of the branchlets and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CLERODENDRUM INDICUM (L.) Kuntze.

Aqueous extracts of the branches and leaves and of the roots were toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CLERODENDRUM INERME Gaertn.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

DURANTA REPENS L. Synonym: D. plumieri. Duranta.

A cold water extract of 10 grams of berries in 100 milliliters of water killed 90 percent of mosquito larvae in 24 hours.--Pendse and coworkers (167).

An aqueous extract of the branchlets, leaves, and fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches. Alcohol, petroleum ether, and chloroform extracts of the fruits were toxic to black carpet beetle larvae but not to German cockroaches, milkweed bugs, and larvae of the webbing clothes moth and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

DURANTA sp.

An aqueous extract of the fruits was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

FARADAYA SPLENDIDA F. Muell.

An aqueous extract of the branches and leaves was highly toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. An aqueous extract of the roots was toxic to American cockroaches only. Alcohol, petroleum ether, and chloroform extracts of the branches and leaves were nontoxic to German cockroaches, milkweed bugs, and larvae of the black carpet beetle, webbing clothes moth, and Aedes and Anopheles mosquitoes.--Heal and coworkers (93).

GMELINA LEICHARDTII F. Muell.

Gmelinol, obtained from the wood, was slightly synergistic with pyrethrins in tests against house flies.--Kerr (114).

LANTANA HORRIDA H. B. K.

An aqueous extract of the roots was very toxic to American cockroaches when injected into the blood stream, but German cockroaches were unaffected after immersion in the extract. Alcohol, petroleum ether and chloroform extracts of the roots were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

LIPPIA CUNEIFOLIA (Torr.) Steud. Synonym: Phyla cuneifolia.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LIPPIA GRAVEOLENS H. B. K.

An aqueous extract of the flower heads and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

LIPPIA sp.

An aqueous extract of the branchlets and leaves was very toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PETITIA DOMINGENSIS Jacq. Fiddlewood.

The wood is susceptible to termites.--Wolcott (225).

PREMNA ODORATA Blanco. Fragrant premna.

The leaves are reported to repel insects. The powdered leaves were nontoxic to house flies, German cockroaches, and the common black ant.--Jacobson (108).

PRIVA LAPPULACEA (L.) Pers.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

STACHYTARPHETA INDICA (L.) Vahl.

Aqueous extracts of the whole plant and of the roots were nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

STACHYTARPHETA JAMAICENSIS (L.) Vahl.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs. An extract of the whole plant was slightly toxic to American cockroaches only.--Heal and coworkers (93).

TECTONA GRANDIS L. f. East Indian teak.

The sapwood is susceptible to termites.--Wolcott (225).

Tectoquinone (beta-methylanthraquinone), a constituent of the resin of this tree, is so repellent to termite attack that, at a dilution of 0.05 percent, the termites would

not even rest on the wood, and three weeks elapsed before they commenced to eat it.--Wolcott (224).

Glass plates treated with DDT and stored in a box made of Burma teakwood showed increased toxicity to insects. Beta-methylanthraquinone mixed with DDT in a 2-percent concentration showed a striking synergistic action against adult female mosquitoes (Culex fatigans).--Ranganathan and coworkers (181).

TIMOTOGIA MANSOI (Schauer) Moldenke.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

VERBENA HASTATA L.

An aqueous extract of the whole plant with fruits was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

VERBENA LITORALIS H. B. K.

An aqueous extract of the tops and leaves was toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

VERBENA URTICIFOLIA L.

An aqueous extract of the whole plant was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

VITEX DIVARICATA Sw. Lizardwood, fiddlewood.

The wood is susceptible to termites.--Wolcott (225).

VITEX NEGUNDO L.

The leaves are used to drive away fleas in the Philippines.--Quisumbing (179).

VIOLACEAE

ANCHIETEA SALUTARIS A. St. Hil.

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HYBANTHUS CONCOLOR (T. F. Forst.) Spreng.

An aqueous extract of the whole plant was very toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs. A petroleum ether extract was toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, and webbing clothes moth larvae. Alcohol and chloroform extracts were nontoxic to all these insects and to Aedes mosquito larvae.--Heal and coworkers (93).

HYBANTHUS YUCATANENSIS Millsp.

An aqueous extract of the roots, stems, and leaves was very toxic to American cockroaches but not to German cockroaches and milkweed bugs. Alcohol, petroleum ether, and chloroform extracts were toxic to black carpet beetle larvae, but not to German cockroaches, milkweed bugs, confused flour beetles, and larvae of the webbing clothes moth and Aedes mosquito.--Heal and coworkers (93).

RINOREA FLAVESCENS (Aubl.) Kuntze.

Aqueous extracts of the roots and of the branches and leaves were toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

VIOLA MAXIMOWICZIANA Makino.

VIOLA PHALACROCARPOIDES Makino.

Aqueous suspensions of the leaves, stems, and roots were all toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

VIOLA RAFINESQUII Greene.

An aqueous extract of the whole plant was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

VIOLA TAKEDANA var. VARIEGATA Nakai.

An aqueous suspension of the leaves, stems, and roots was toxic to Drosophila hydei larvae.--Yamaguchi and coworkers (233).

VITACEAE

AMPELOPSIS ARBOREA (L.) Kochne. Pepper vine.

The powdered stems and leaves were nontoxic to cabbage loopers, melonworms, and southern armyworms.--Bottger and Jacobson (36).

The powdered stems and leaves were ineffective against European corn borer larvae. Combined petroleum ether, ethyl ether, chloroform, and alcohol extractives were ineffective against house flies and codling moth larvae.--Jacobson (108).

CISSUS CAUSTICA Tussac. Bejuco bravo.

An acetone extract of the stems was ineffective against mosquito larvae.--Jacobson (108).

CISSUS EROSA L. C. Rich.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CISSUS INCISA (Nutt.) Des Moulins.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CISSUS SICYOIDES L. Cissus.

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

CISSUS TRIFOLIATA L.

An aqueous extract of the stems and roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PARTHENOCISSUS QUINQUEFOLIA (L.) Planch.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

RHOICISSUS ERYTHRODES (Fres.) Planch.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

VITIS sp. Grape.

Grape kernel oil was not very promising against San José scale.--Viel (216).

VOCHYSIACEAE

VOCHYSIA MAXIMA Ducke.

VOCHYSIA TETRAPHYLLA DC.

The wood of these species is susceptible to termites.--Wolcott (225).

XYRIDACEAE

XYRIS IRIDIFOLIA Chapm.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

ZINGIBERACEAE

AFRAMOMUM MELEGUETA (Rosc.) K. Schum. Grains of paradise.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

An acetone extract of the whole plant was ineffective against mosquito larvae.--Hartzell (90).

CURCUMA LONGA L.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CURCUMA ZEDOARIA Rosc. Zedoary.

An acetone extract of the roots was ineffective against mosquito larvae.--Hartzell (90).

ELETTARIA CARDAMOMUM (L.) Maton.

An aqueous extract of the seeds was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

HEDYCHIUM CORONARIUM Koenig.

An aqueous extract of the rhizomes was toxic to American cockroaches when in-

jected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

RENEALMA sp.

An aqueous extract of the seeds was nontoxic to German and American cockroaches.--Heal and coworkers (93).

ZINGIBER OFFICINALE Rosc.

Acetone and water extracts of the roots were ineffective against mosquito larvae.--Hartzell (89).

ZYGOPHYLLACEAE

FAGONIA CALIFORNICA Benth.

An aqueous extract of the above-ground portions was toxic to American cockroaches when injected into the blood stream but German cockroaches and milkweed bugs were unaffected after immersion in the extract.--Heal and coworkers (93).

GUAIACUM OFFICINALE L. Guiac, lignum-vitae.

The heartwood is very resistant to termite attack, while the sapwood is not.--Wolcott (224).

An aqueous solution of a saponin obtained from the bark was ineffective against mosquito larvae.--Jacobson (108).

LARREA TRIDENTATA (DC.) Coville. Synonym: Covillea tridentata. Greasewood, creosote bush.

The powdered roots were nontoxic to Hawaiian beet webworms.--Bottger and Jacobson (36).

An acetone extract of the stems showed little toxicity to mosquito larvae. Ethyl ether and acetone extracts of the stems and of the roots were nontoxic to aphids. The powdered roots and their petroleum ether and alcohol extractives showed some toxicity to codling moth larvae, but the extracts had no effect on house flies. The resin obtained from the stems had no effect on European corn borer larvae, codling moths, house flies, and German cockroaches.--Jacobson (108).

An aqueous extract of the stems and leaves was slightly toxic to American cockroaches and nontoxic to German cockroaches.--Heal and coworkers (93).

PEGANUM HARMALA L.

An aqueous extract of the whole plant with fruits was nontoxic to German and American cockroaches.--Heal and coworkers (93).

TRIBULUS TERRESTRIS L.

An aqueous extract of the whole plant was nontoxic to American cockroaches.--Heal and coworkers (93).

ZYGOPHYLLUM FABAGO L.

An aqueous extract of the whole plant was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

UNIDENTIFIED PLANTS

The following common, local, or native names have not been identified botanically.

AGUACATILLO.

The wood of this Panamanian tree, possibly a species of Ocotea, is resistant to termites.--Wolcott (226).

ALMÁCIGO.

The wood of this West Indian tree is susceptible to termite attack.--Wolcott (224).

ALMENDRÓN.

The wood is resistant to termites.--Wolcott (225).

BALBEC.

An acetone extract of the roots was ineffective against mosquito larvae.--Jacobson (108).

BALSAMO DO CAMPO.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BARBASCO COMUN.

An aqueous extract of the stems was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

BARBASCO NEGRITO.

An acetone extract of the stems from Venezuela was ineffective against mosquito larvae.--Jacobson (108).

BARBASCO VIANI.

The powdered roots from Colombia were nontoxic to southern armyworms, melonworms, and codling moth larvae but showed some toxicity to cross-striped cabbage worms. Combined petroleum ether and ethyl ether extractives as well as combined chloroform and alcohol extractives each showed no toxicity to codling moth larvae, but the combined chloroform and alcohol extractives showed some toxicity to German cockroaches.--Jacobson (108).

BEJUCO CHILIO.

An acetone extract of the stems from El Salvador was ineffective against mosquito larvae.--Jacobson (108).

BEJUCO DE CANDELARIA.

BEJUCO DE REATA.

Acetone extracts of the stems from Mexico were ineffective against mosquito larvae.--Jacobson (108).

BETIT-BEER.

An acetone extract of the roots from Venezuela was ineffective against mosquito larvae.--Jacobson (108).

CALUMBA.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CAMBUCA.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CAMPALCA.

An acetone extract of the stems from Honduras was ineffective against mosquito larvae.--Jacobson (108).

CASCARA TIMICO.

An acetone extract of the bark from Peru was toxic to mosquito larvae.--Jacobson (108).

CATUABA.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CHAMAIRO.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CHICHILEGUA.

An aqueous extract of the roots was nontoxic to German and American cockroaches and milkweed bugs.--Heal and coworkers (93).

CHOCHO.

An aqueous extract of the seeds was nontoxic to German and American cockroaches.--Heal and coworkers (93).

CIBO TRIPA DE GALINHA.

An aqueous extract of the roots was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CIPO CABELUDO.

An aqueous extract of the roots was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

CORTEZA AMARILLA.

An acetone extract of the roots showed some toxicity to mosquito larvae.--Jacobson (108).

FLAMBOYÁN.

The wood of this West Indian tree is susceptible to termite attack.--Wolcott (224).

GUAYAVILLO DE MONTANA.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic

to German cockroaches.--Heal and coworkers (93).

HERVA DE STA. CRUZ.

An aqueous extract of the roots was very toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HIERBA DEL CANCER.

An aqueous extract of the stems was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

HIERBA DEL TORO.

An aqueous extract of the whole plant was very toxic to American cockroaches when injected into the blood stream, but German cockroaches and milkweed bugs were unaffected after immersion in the extract. Aqueous extracts of the tops, leaves, and fruits and of the stems and leaves were nontoxic to all these insects.--Heal and coworkers (93).

HUAMANSAMA.

An acetone extract of the leaves from Peru was ineffective against mosquito larvae.--Jacobson (108).

HUMACATE RABO DE IGUANA.

A saponin from the acetone extract of the stalks was nontoxic to codling moth larvae.--Jacobson (108).

LENTEJA BOCCONA.

The powdered seeds of this leguminous plant from Peru were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

MACHA.

An acetone extract of the plant was ineffective against mosquito larvae.--Jacobson (108).

MULVULA.

An aqueous extract of the stems was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

MUSHAMA KUBA.

An aqueous extract of the bark was slightly toxic to American cockroaches and nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

PEITONAL DE ANGICO.

An aqueous extract of the bark was nontoxic to German and American cockroaches.--Heal and coworkers (93).

PESQUA.

An acetone extract of the plant was ineffective against mosquito larvae.--Jacobson (108).

PRINGAMOZA.

The plant is used in Nicaragua as an insecticide.--Higbee (94).

PURGA LAGARTO.

An aqueous extract of the roots was very toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

SINACA, UNA DE GATO.

This woody vine, possibly Bignonia unguis-cati, is reportedly used to stupefy crabs and to kill mosquitoes. The powdered leaves and stems were nontoxic to southern armyworms and melonworms but toxic to southern beet webworms. The powdered wood was toxic to southern beet webworms, but not to celery leaf tiers. An alcohol extractive of the wood was toxic to all these insects but nontoxic to large milkweed bugs. Petroleum ether, ethyl ether, and chloroform extractives of the wood were all nontoxic to these insects.--Bottger and Jacobson (36).

The powdered leaves and stems and the powdered wood were nontoxic to European corn borer larvae. An alcohol extractive of the wood was also nontoxic to this insect. Combined petroleum ether, ethyl ether, chloroform, and alcohol extracts of the wood were nontoxic to house flies.--Jacobson (108).

SINIHUITE.

An acetone extract of the roots from El Salvador was ineffective against mosquito larvae.--Jacobson (108).

TANICA.

The powdered vine showed no repellency or toxicity to house flies and ants.--Jacobson (108).

TAPIRAMO.

The powdered seeds from Venezuela were nontoxic to Mexican bean beetle larvae.--Hansberry and Clausen (86).

TIMBO-MIRIM.

An aqueous extract of the roots was very toxic to American cockroaches but nontoxic to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ZARAPARILLA.

An aqueous extract of the stems and leaves was toxic to American cockroaches but not to German cockroaches and milkweed bugs.--Heal and coworkers (93).

ZORILLA.

The plant is used in Nicaragua as an insecticide.--Higbee (94).

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B.

Market Diseases

of

EETS, CHICORY, ENDIVE, ESCAROLE GLOBE ARTICHOKES, LETTUCE RHUBARB, SPINACH, AND SWEETPOTATOES

Glen B. Ramsey, B. A. Friedman, and M. A. Smith

Agriculture Handbook No. 155

TED STATES DEPARTMENT OF AGRICULTURE
ultural Marketing Service
eting Research Division

THIS REPORT is the ninth in a series of publications on marke diseases of fruits and vegetables. The publications are designed t aid in the recognition and identification of pathological conditions c economic importance affecting fruits and vegetables in the channe of marketing in order to facilitate inspection of these food produc and to prevent losses from such conditions.

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292. Crucifers and Cucurbits. June 1938.
340. Grapes and Other Small Fruits. July 1939.
440. Asparagus, Onions, Beans, Peas, Carrots, Celery, and Rela Vegetables. Sept. 1941.
498. Citrus and Other Subtropical Fruits. June 1943.

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BEETS, CHICORY, ENDIVE, ESCAROLE, GLOBE ARTICHOKES, LETTUCE, RHUBARB, SPINACH, AND SWEETPOTATOES

By GLEN B. RAMSEY, *principal pathologist*, B. A. FRIEDMAN and M. A. SMITH, *senior pathologists*, Biological Sciences Branch, Agricultural Marketing Service

BEETS

The beet (*Beta vulgaris* L.) is grown primarily for its fleshy roots, although the young, succulent tops are often used as greens. The choicest of the garden varieties have a rich red color and are moderate sized, smooth and sweet, and of fine texture.

Early garden beets are usually marketed in fresh, crisp condition. The tops are especially susceptible to decay by bacterial soft rot organisms. Cercospora leaf spot sometimes disfigures the tops of garden beets. Any leaf disease which reduces the normal leaf area of the plant, such as curly top (virus) or rust (*Uromyces betae* (Pers.) Lev.), is likely to cause dwarfing and poor development of the root. The growing root is subject to black rot (*Phoma betae* (Oud.) Fr.), crown gall (*Agrobacterium tumefaciens* (E. F. Sm. and Town.) Conn), fusarium rot (*Fusarium* spp.), and root rot (*Pellicularia filamentosa* (Pat.) Rogers).

The late beet crop is topped and either marketed immediately or stored for winter use like potatoes. Beets without mechanical wounds and free from disease will remain firm and crisp for several months if stored in a cool place. The mature roots are not subject to many diseases. Occasionally they are affected by black rot, blue mold rot (*Penicillium* sp.), fusarium rot, internal black spot, and scab.

BACTERIAL SOFT ROT

(*Erwinia carotovora* (Jones) Holland and other organisms)

Bacterial soft rot is not as common on the roots of beets as it is on other root crops, such as carrots and turnips. However, it is the chief cause of loss of leaves and stems of beets when they are shipped and marketed as young bunch beets.

Breaks in the protective skin, moderate temperatures, and moisture are predisposing factors to this rot. Young beets are easily bruised in

NOTE: Illustrations of the diseases are inserted at the back. The photograph for plate 9, C was furnished by the Virginia Truck Crop Experiment Station.

harvesting, and the leafstalks are often wounded when the beets are tied into bunches.

The first symptoms of this rot on leafy tissues are darkened, water-soaked areas which increase rapidly in size. The affected tissues soon become soft and slimy and have a disagreeable odor.

(See also Spinach, Bacterial Soft Rot, p. 18.)

BLACK ROT

(*Phoma betae* (Oud.) Frank)

Black rot sometimes affects garden beets, but usually causes only slight loss except in topped roots that have been held in storage. It is rarely if ever found on young bunch beets on the market.

Beets in storage usually show black rot at the tip of the root, although it occasionally occurs at the crown and in wounds on the side of the root. Because of the color of the beets, the small lesions are usually overlooked. The decay is seldom observed until the affected tissues become black and slightly sunken or until a flat, grayish white surface mycelium becomes evident (pl. 1, *A*). Internally the decayed areas are dark brown to black with a sharp line of demarcation between the healthy and diseased tissue (p. 1, *B*). At first the invaded tissues are brown and water-soaked, but in the older lesions the affected tissues are black and somewhat granular, eventually becoming dry and spongy. With age, cavities lined with mycelium may be found within the spongy tissue of the larger lesions. Although considerable grayish white mycelium develops on the surface of the older lesions under humid conditions no pycnidia have ever been observed on the beets.

Cultures of the causal fungus (*Phoma betae*) will grow throughout a temperature range of 35° to 95° F. but the optimum temperature is 75° F. Beets artificially infected through slight wounds develop decayed areas about ¼ inch in diameter at 45° F. and ½ inch at 55° within 6 weeks. The decay develops more rapidly in old beets than in young ones.

When affected seedlings survive and produce marketable roots the fungus is usually present in the crown where it may remain dormant for some time. In storage it often becomes active and penetrates the roots causing a black, rather dry rot. In some instances infection may also take place through injuries or follow other diseases.

Close topping of roots and storage in slatted crates at temperatures near 32° F. will retard the development of black rot.

(See *48*.) [1]

CERCOSPORA LEAF SPOT

(*Cercospora beticola* Sacc.)

Cercospora leaf spot is one of the most common and best known diseases of the beet. It is of direct importance from the market point of view because it disfigures the leaves, and bacteria sometimes enter through the leaf spots and cause soft rot.

[1] Italic number in parentheses refer to Literature Cited, p. 35.

Small, definitely outlined spots are produced on the leaf. The margin between the diseased and the healthy tissue is reddish brown to purple, and the center of the spot is ashen gray to light tan.

The causal fungus lives over from season to season mainly in old beet tops. The removal of beet trash and deep plowing are recommended as control measures. No varieties of table beets are resistant to this disease.

(See *74*, *86*.)

INTERNAL BLACK SPOT

In many localities, internal black spot is a serious disease of garden and canning beets. On the market it is found on topped and stored beets, but rarely on young bunch beets. This trouble develops in plants grown in soils deficient in boron. It may occur in various types of soil, but it is most often serious in alkaline soils, which tend to make boron unavailable to the plants.

Internal black spot is characterized by irregular patches of dark colored tissue, usually in the center of the root. The discolored areas are moist and of about the same texture as normal tissue. They do not dry, form cavities, or cause unusual shrinkage. Beets may be severely affected without showing external symptoms. However, occasionally some tissues near the surface are affected and cracks occur; these permit secondary rot-producing fungi to enter.

This trouble may be avoided by applying borax to the soil. As the amount needed varies with different types of soil, the recommendations of local authorities should be followed.

(See *91*, *119*, *121*.)

SCAB

(*Streptomyces scabies* (Thaxt.) Waks. & Henrici)

Scab is comparatively rare on beets, but occasionally it causes ap-
reciable damage in heavily infested soil. The pathogen is the same
ie that causes common scab on potatoes. On beets the scab lesions are
iperficial and much like those on potatoes except that they usually are
ore protruding and rounded. Affected roots are so conspicuously
emished that they are seldom offered on the market.

(See *70*.)

CHICORY, ENDIVE, AND ESCAROLE

Endive for the market consists of the leafy heads of *Cichorium
divia* L., and is an annual or biennial salad plant. The leaves of
nmercial endive are narrow, curled, and more or less finely divided.
idive is often called "chicory."

Chicory, as correctly used, refers to the leafy heads of a perennial
int (*Cichorium intybus* L.) that is closely related to endive. Aside
om matured roots which are ground, dried, and mixed with coffee,
cory is used mainly as a salad plant in the form of small, slender,
ipact blanched leaf heads. At the present time none is grown
nmercially in the United States and all supplies are imported from
gium where they are grown under specialized culture conditions.

In this country they are marketed as "witloof" (Dutch for "white-leaf").

Escarole consists of the broad-leaved varieties of endive. Escarole heads have rather thick, broad, somewhat twisted and waved leaves with broad, nearly white midribs. The leaves of escarole are larger and more fleshy than those of the common narrow-leaved endive. It is used chiefly as a salad plant.

The important field diseases of endive and escarole are bacterial soft rot, bottom rot, downy mildew, gray mold rot, watery soft rot, and two virus diseases (mosaic and yellows). The serious market diseases of these plants are bacterial soft rot (pl. 5, *D*), marginal browning, and watery soft rot. The only two serious transit and market diseases of witloof chicory are bacterial soft rot and watery soft rot (pl. 5, *B*).

Chicory, endive, and escarole are salad plants closely related to lettuce. Their diseases are so similar to those of lettuce that they are described later in the section devoted to lettuce diseases.

(See *49*.)

GLOBE ARTICHOKES

Globe artichokes for the market are the immature flower heads (buds) of *Cynara scolymus* L., a herbaceous perennial plant. The fleshy flower base or receptacle, the young flowers, and the tender base of the bracts or scales together make up the edible portion.

The globe artichoke should not be confused with the Jerusalem-artichoke (*Helianthus tuberosus* L.), which is grown for its underground tubers.

Marketability of the buds depends upon their stage of maturity, their freshness, and their freedom from disease and insect injuries. The buds must be harvested before they are too mature; otherwise the receptacle and scales will be tough and lack flavor. Toughness and drying-out may also occur in small buds produced on old plants or in buds that are held too long or in a dry place after harvest.

The only market disease of significance is gray mold rot. Buds damaged by bruising, field freezing, and feeding of the artichoke plume moth larvae (*Platyptilia carduidactyla* (Riley)) are frequently seen on the market.

(See *59*, *114*.)

FREEZING INJURY

Globe artichokes freeze at about 29° F. Severe freezing kills the buds and causes them to turn black. Slight freezing results in breaking, cracking, and blistering of the epidermis on the exposed parts of the outer bracts. The loosened areas of the epidermis are whitish, and the bud as a whole may become somewhat browned. This detracts considerably from the market appearance of the buds.

(See *114*.*132*.)

GRAY MOLD ROT

(*Botrytis* sp.)

Occurrence and Importance

Gray mold rot is at times an important field disease and is regularly the most prevalent market disease of globe artichokes. Along

the coastal districts of central California where globe artichokes are most extensively grown this decay often causes serious loss.

Under humid conditions the lesions of gray mold rot are moist to wet, odorless, and reddish brown or brown (pl. 2, *A* and *C*). The borders are definite and slightly water-soaked. Under dry conditions the advancing edge is not water-soaked and the affected tissues are dark brown, dry, and firm. Decay lesions can be distinguished from bruised areas by the deeper penetration of the discoloration.

Lesions may appear anywhere on the bud. Commonly they originate at the cut surface of the stem and at the tips of the bracts where splitting has occurred (pl. 2, *C*). Under humid conditions the decayed areas become covered with the grayish mycelium and the velvety, grayish-brown spore masses of the pathogen, which are characteristic signs of the disease (pl. 2, *B*).

Causal Factors

Gray mold rot is caused by a species of *Botrytis* of the *cinerea* type. The fungus is found wherever vegetables are grown, since it is able to live on plants of many kinds. Spores produced abundantly under humid conditions are carried by air currents to growing plants in the field. Wounds and other breaks in the epidermis facilitate infection but the mycelium can readily penetrate moist unbroken tissues. Dead or dying tissues or those weakened by freezing or other unfavorable conditions are more readily infected than vigorous, healthy ones.

The pathogen has a wide temperature range, from about 28° to 90° F., for growth, sporulation, and spore germination. Optimum temperatures are approximately 75° to 77°. The fungus makes only slight growth at 28° to 32°, but it is able to grow sufficiently at these low temperatures to become established in the plant tissues. It is because of this that vegetables which appear sound when removed from refrigerator cars or from cold storage may develop gray mold rot very rapidly when exposed to higher temperatures.

Moisture is much more of a limiting factor than temperature for growth of the fungus, germination of the spores, and infection of plant tissues. The disease is particularly important under conditions of moderate temperature and high humidity.

Control Measures

The most satisfactory way to reduce losses from gray mold rot is to cool the artichokes as soon as possible after harvest and to maintain as low refrigeration temperatures as practicable during the transit and marketing periods. Field sanitation practices and care in harvesting and packing also help. Where artichokes are held on the market it is advisable to maintain a low temperature and as low humidity as possible, without causing withering.

(See *68*.)

LETTUCE

Lettuce for the market consists of the leaves or leafy heads of the lettuce plant (*Lactuca sativa* L.). Other common salad vegetables related botanically to lettuce are chicory, endive, and escarole.

There are five types of lettuce, namely, the crisphead or "iceberg" varieties; the butterhead varieties; the romaine, or cos, varieties; the looseleaf, or bunching varieties; and the stem types. Practically all leafy parts of each type of lettuce are marketed, consequently any leaf blemish or decay affects directly the marketability of the crop. Even in the crisphead types, lesions on the loose outer wrapper leaves may be important on the market for they may lead to secondary decays which spread to the head leaves. Diseases of the roots, stems, or leaves may be indirectly important on the market through stunting of plants, production of loose heads, and production of leaves that are poorly colored, bitter, tough, or wilted.

The most important defects and diseases affecting lettuce in the field and greenhouse are anthracnose (*Marssonina panattoniana* (Berl.) Magn.), bacterial soft rot, bottom rot (*Pellicularia filamentosa* (Pat.) Rogers), damping-off (*Pythium* spp, and other fungi), downy mildew, drop or watery soft rot, gray mold rot, tipburn, rib discoloration, and the virus diseases aster yellows, big vein, mosaic, and spotted wilt. There are several leaf diseases of lettuce, such as anthracnose, *Cercospora* spot (*C. longissima* Sacc.), powdery mildew (*Erysiphe cichoracearum* DC.), *Septoria* spot (*S. lactucae* Pass.), and *Stemphylium* spot (*S. botryosum* Wallr.), which occasionally cause losses in field or greenhouse plantings. These diseases, however, are seldom seen on the markets, apparently because the affected leaves are trimmed before shipment.

At the present time the most serious defects and diseases of lettuce on the market are bacterial soft rot, bruising injury, downy mildew, freezing injury, gray mold rot, marginal browning, rib discoloration, russet spotting, tipburn, and watery soft rot.

(See *9, 30, 33, 69, 117, 118, 120, 125.*)

BACTERIAL SOFT ROT

(Pseudomonas spp. and other bacteria)

Occurrence, Importance, and Symptoms

Bacterial soft rot, often called "slime", is the most serious market disease of lettuce. The decay usually starts on bruised leaves or at the leaf margins following tipburn or marginal browning. Bacterial soft rot often follows secondarily after other diseases such as russet spotting, downy mildew, gray mold rot, or freezing injury. Infected tissue is watersoaked at first, and may not be discolored or may show various shades of russet or brown (pl. 3, *E*). As the decay develops, the heads become soft, slimy, mushy, and wet (pl. 3, *F*). Such heads usually have no putrid odor. Leaf veins, especially the smaller secondary veins, which radiate out from rotted areas may become russet colored before they rot. Under dry conditions infected areas of outer leaves may dry up and become papery in texture.

Causal Factors

The pathogens most commonly isolated from lettuce affected with bacterial soft rot are *Pseudomonas marginalis* (Brown) Stevens and *P. cichorii* (Swingle) Stapp. Less commonly, *P. viridilivid*

(Brown) Holland, *Xanthomonas vitians* (Brown) Starr and Weiss, and *Erwinia carotovora* (Jones) Holland are obtained.

Although some decay may occur at temperatures as low as 32° F., bacterial soft rot develops slowly at 45° or lower. Between 60° to 85° bacterial soft rot of lettuce develops very rapidly under humid conditions. Above 90° the decay caused by *Pseudomonas* and *Erwinia* is less rapid.

Control Measures

Losses from bacterial soft rot may be reduced by shipment of lettuce free from tipburn, careful trimming to eliminate leaves affected by diseases and defects, rapid precooling, and the use of low refrigeration temperatures during the transit and marketing period.

(See *11*, *24*, *26*, *80*, *108*.)

DOWNY MILDEW

(*Bremia lactucae* Reg.)

Occurrence and Importance

Downy mildew occurs commonly in this country and elsewhere on both field-grown and greenhouse-grown lettuce. At eastern terminal markets in this country downy mildew is regularly seen on California-grown lettuce.

Symptoms

The disease causes light-greenish to yellowish areas up to about one-half inch in diameter on the upper surface of the older wrapper leaves. Under conditions of high humidity and moderate tempera-tures a fuzzy, whitish-gray mold develops on the lower surface of he infected areas (pl. 4, *B*). Later the diseased areas turn brown (pl. 4, *A*), and usually become soft and slimy as secondary decays, specially bacterial soft rot and gray mold rot enter. Occasionally, lowny mildew may spread in transit and storage from the wrapper eaves to the outer head leaves causing a light brown discoloration and ometimes developing a surface mold growth.

Causal Factors

The downy mildew fungus is an obligate parasite, and consists of t least five physiologic races which vary in their pathogenicity for ifferent strains of lettuce. Several of the Imperial varieties were ormerly immune to some of the biologic races of *Bremia lactucae*, ut recently new mildew races have appeared to which none of the ommercial varieties now in production is immune. Varietal immu-ity is highly specific, that is, immunity against one race of downy ildew may be wholly ineffective against another race.

Control Measures

When downy mildew is prevalent in the field, and transit temper-ures are above 40° F., considerable infection may be evident at rminal markets on California-grown lettuce. At the present time,

the best control of downy mildew during marketing is by the trimming of the older wrapper leaves, rapid precooling after packing, and transporting at temperatures as close to 32° as possible.

(See *8, 9, 120, 129.*)

GRAY MOLD ROT

(*Botrytis cinerea* Pers.)

Occurrence and Importance

In recent years the occurrence of gray mold rot on the market has been sporadic and usually of minor importance. At times, however, gray mold rot may occur and cause extensive decay of field-grown lettuce. Formerly, the disease caused serious losses of greenhouse-grown lettuce. Gray mold rot also occurs on escarole and endive but is seldom serious on these vegetables.

Symptoms and Causal Factors

Lettuce tissue affected by gray mold rot is watersoaked and grayish-green or brownish in appearance. As the decay progresses the affected tissue becomes soft and slimy. At this stage characteristic smoky-gray mycelium and spore masses usually develop (pl. 5, *C*). Decayed heads usually have no definite odor. Gray mold rot develops occasionally in tipburn-injured tissue. Soft rot bacteria may invade tissue rotted by the gray mold fungus.

On culture media the gray mold fungus has its most rapid growth from about 70° to 77° F., with a temperature range reported from about 28° to 90°. The fungus is somewhat more active below 70° than it is above 77°.

Control Measures

The destruction of diseased plants and plant trash in the field and packing house has been reported to reduce gray mold rot. Trimming of older wrapper leaves, rapid precooling, especially by vacuum methods of cooling after harvest, careful handling to prevent injuries, low refrigeration temperatures during transit and marketing, and quick retail turnover reduce losses during marketing.

(See also Globe Artichokes, Gray Mold Rot, p. 4.)

(See *8, 106, 120.*)

MARGINAL BROWNING

Marginal browning is a term used to describe a yellowing followed by a browning or necrosis of the margins of the wrapper or outer leaves of head lettuce and romaine (pl. 5, *F*). In some ways marginal browning resembles tipburn but the former does not occur on the inner or head leaves; the browned leaf margins in marginal browning are usually wider and the discoloration darker.

Marginal browning is apparently physiological in origin and probably caused by adverse growing conditions (as hot, dry winds or other factors) or by improper conditions in transit or storage (as inadequate refrigeration.) Most of the marginal browning seen on market lettuce is probably of transit origin and appears to be associated with se-

nescence. Marginal browning is almost always followed by bacterial soft rot under conditions of high humidity and warm temperatures.

A somewhat similar type of marginal browning occurs on escarole. Ordinarily the outermost four to six whorls of leaves on the marketed leaf heads are affected. The completely blanched center leaves have never been found affected. The injury usually extends 1/4 to 1 inch from the leaf tip. The edges of the leaf blade are also frequently affected for an inch or two. As tissues dry they turn dark, curl up, become brittle, and are usually rather sharply set off from the healthy tissues. This condition is found frequently in Florida-grown escarole and occasionally affects a high percentage of the heads.

On endive a marginal browning affects the frayed edges and tips of the blanched heart leaves (pl. 5, *E*). Associated with this is the development of numerous minute reddish-brown spots or streaks one thirty-second to one sixteenth of an inch in length on the fleshy midribs. Generally neither the green tips of the partially blanched leaves nor the outer leaves are affected. This injury has been observed on California-grown endive, and in many instances a very high percentage of the heads are affected. Some evidence indicates that this condition develops in transit to distant markets.

Control Measures

Losses from marginal browning of head lettuce and escarole may be reduced by avoiding the shipment of overmature heads, removal of older wrapper leaves, rapid precooling, low refrigeration temperatures during handling, and a rapid marketing period. While these measures will improve market quality, it is not known whether they will control marginal browning of endive.

PINK RIB

Occurrence, Importance, and Symptoms

Occasionally heads of lettuce are seen on the market with a faint to pronounced pinkish discoloration of the midrib (pl. 3, *C*). Slightly affected midribs show the discoloration on the inner side of the rib only, while more severely affected midribs show the discoloration on both surfaces. Otherwise the midribs show no other symptoms, that is, there are no spotted, pitted, or sunken areas. Apparently associated with pink rib, the head leaves often have a somewhat dried-out appearance, and are wrinkled, pebbly, or corrugated in texture. Pink rib is not ordinarily followed by bacterial soft rot.

Causal Factors

Pink rib is apparently a physiological disorder but its cause is not known. It is apparently distinct from rib discoloration. (See p. 10.) Pink rib may occur in the field, but is most commonly seen on heads which appear to have been harvested over-mature or to have been in transit or storage for a prolonged period. Pink rib may develop in transit and storage, and has been reported to be more severe at 47° F. storage than at 37°.

Control Measures

Little is known about the control of pink rib, but there is some evidence that the measures recommended for the control of marginal browning (p. 8) may reduce pink rib.

(See *75*.)

RIB DISCOLORATION

Occurrence and Importance

On eastern markets rib discoloration has been found in head lettuce originating in Arizona, California, Texas, Florida, Georgia, Virginia, and New York. In lettuce from the Far West the condition is most serious in the crop harvested during the spring of the year. The condition has not been reported on escarole or endive.

Symptoms

In slightly affected heads rib discoloration, which has also been called rib blight and rib rot, appears as a creamy-yellow or light brown area on the inner surface of the midrib or secondary ribs (and veins) of the leaf. The discolored area is usually less than one inch in length and about one-quarter inch wide. The affected tissues are firm, and at this stage the lesions are not sunken, pitted, or slimy. Frequently at this time only a slight discoloration can be seen on the outer surface of the affected ribs. Rib discoloration is usually found on one or a few of the outer head leaves but may occur also on the inner head leaves and occasionally on the wrapper leaves (pl. 3, *B*). It usually is found at the area of greatest curvature of the folded leaves, but may also occur close to the butt of the head or farther out on the leaf on the secondary ribs. In more advanced stages, rib discoloration becomes reddish-brown, greenish-brown, or dark brown. The discolored area may extend from 1 to 3 inches in length and up to three-quarters inch in width, is clearly visible on both surfaces of the leaf, and the affected rib tissues are sunken and occasionally cracked. Bacterial soft rot often follows the advanced stages of rib discoloration causing a slimy rot.

Causal Factors

Rib discoloration is apparently a physiological disturbance which originates in the field but the factor or factors that cause the condition are not known. Different lettuce varieties and strains show considerable variation in susceptibility. The condition may develop in Imperial, Great Lakes, and other commercial varieties now in production. Rib discoloration progresses some in transit and storage. While it is believed by some growers that rib discoloration and tipburn are related, evidence indicates that the occurrence and severity of these two physiological conditions are not necessarily correlated.

Control Measures

At the present time measures for the control of rib discoloration are not known.

(See *8*, *27*, *33*.)

RUSSET SPOTTING

Occurrence and Importance

Russet spotting is often a serious disorder of head lettuce on the market. It is thought to be more serious on the Great Lakes variety but it occurs on other varieties also. It has not been observed on other types of lettuce or on escarole or on endive. Russet spotting has been found on eastern-grown as well as western-grown head lettuce.

Symptoms

The symptoms of russet spotting are quite variable. The spotting nay consist of a few to numerous specks less than 1/16-inch in diameter or of spots 1/8-inch to several inches in diameter. The spots are isually irregular in shape. In the early stages these are light yelow; later they become pink, brown, olive-brown, or dark brown but he predominant color is russet (pl. 3, *A*). They may appear any blace on the leaf but have a tendency to be most common nearer the ase of the head. They may be on the ribs, veins, or on the leaf tisue between the veins. Russet spotting usually first appears on the nner surface of the leaves; later both surfaces are affected. Affected issues may become infected by secondary organisms. Bacterial soft ot or other decay often follows russet spotting.

Causal Factors

There are a number of leaf discolorations of head lettuce of field, ransit, and storage origin which often cannot be separated with ceruinty from each other, especially at terminal markets. Some of these iscolorations are of physiological or uncertain origin such as russet, rown blight, rust, vein browning, redheart, internal browning, rown spot, or storage breakdown. One type appears to develop on ttuce grown on saline soils. Another type is apparently caused by hylene emanations in storage. Others are caused by virus diseases ich as spotted wilt (pl. 6), aster yellows (internal breakdown nase), or lettuce mosaic (necrotic phase). Another type is a form russet spotting or vein browning that may follow leaf decay, prinpally that caused by bacterial soft rot. The term russet spotting is ed to include all of the above types of leaf spotting but not rib scoloration, pink rib, marginal browning, or leaf spots of fungal igin such as anthracnose, *Stemphylium* leaf spot and others.

While russet spotting may be found in the field, most appears to velop during transit and storage. In storage tests little or no sset spotting developed at 32° F., considerable at 45°, and less at ° (but there was more decay at the latter temperature).

Control Measures

The amount of russet spotting that appears on the market can parently be reduced by not shipping overmature heads, by more id shipping point inspections, by rapid precooling after harvest, use of transit temperatures close to 32° F., and rapid marketing lettuce to avoid a long interval between harvest and use. (See *9, 27, 33, 34, 51, 97, 99, 100.*)

TIPBURN

Occurrence and Importance

Tipburn occurs wherever head lettuce is grown and may cause serious losses in the field and during marketing. It is less common and important on leaf lettuce, endive, or escarole.

Symptoms

Tipburn starts as small, translucent flecks or spots near the margins of the outer head leaves or inner wrapper leaves. The lesions increase in number, enlarge, and coalesce with the result that the leaf margins wilt, turn brown, and become necrotic, thus forming an irregular brown border on the leaf margins (pl. 3, *D*). Affected margins may vary from ⅛-inch up to ½-inch or more in width. Veins in the vicinity of lesions usually darken. Tipburn in affected heads may range from one small lesion on a single leaf to many large lesions on numerous leaves. It may extend well into the head, but usually the youngest center leaves are not diseased. Tipburn is not always apparent from the outside of the head, and cutting is often necessary to reveal its presence. The affected tissues may become dry and papery in texture, but more usually they remain moist. In the latter case, soft rot bacteria often enter diseased tissues causing "slime." In transit and during marketing most tipburn is followed by slimy soft rot (pl. 3, *E*).

Causal Factors

Tipburn is a physiological disease, but the exact cause of the breakdown is not known. The disease occurs commonly when lettuce is making rapid succulent growth at the time the heads are maturing. It appears usually when there is a soil water deficiency, low soil temperature, and when the difference between the maximum air temperature and maximum soil temperature is greatest. The latter condition occurs generally when a cool, cloudy or rainy period is followed by a sunny, dry period. In addition, it is believed that tipburn may also be caused by an accumulation of excessive amounts of respiratory products in the sensitive tissues during warm nights.

Control Measures

Reduction of losses at terminal markets from tipburn depends upon rigid grading and inspection for the disease at shipping points, rapid precooling, transport of lettuce at temperatures close to 32° F. and rapid marketing to reduce the amount of secondary bacterial soft rot that follows tipburn.

(See *3, 8, 9, 27.*)

VIRUS DISEASES

There are several virus diseases which affect lettuce, endive, escarole and chicory. These diseases include aster yellows, big vein, mosaic and spotted wilt. If plants are affected in the field in the early stage of growth they usually do not form marketable heads. Plants a

fected by these virus diseases in the later stages of growth may form heads that find their way to the market.

ASTER YELLOWS. This disease, caused by eastern and western strains of viruses, is widespread in this country. It may cause severe losses in the summer crop of lettuce in the East where it has limited production in some areas. Aster yellows is not serious in the Far West. Plants attacked after heading have twisted, dwarfed, and curled heart leaves and the heads do not become firm. Affected heads may also develop an internal brown leaf spotting composed of dried latex that resembles somewhat russet spotting. The symptoms of aster yellows are somewhat similar on escarole and endive but twisting of the inner leaves is less pronounced. Control of aster yellows consists of the field application of insecticides to control the leafhopper vector, and the elimination of weeds and ornamental hosts.

BIG VEIN. Big vein occurs throughout the United States, and affects all lettuce varieties. Field losses are caused by a reduction in yield and poor quality. Infected plants usually form heads. Affected heads show a clearing and translucency of the veins which makes them appear bigger. Leaf tissue is wrinkled, thickened, and puckered. There is little or no mottling. Heads are generally smaller in size, less firm, coarse, ribby, unattractive, and the leaves have a poor texture and flavor. Big vein is caused by a soil-borne agent apparently a virus. It is not seed-borne. The disease is most common in wet, heavy soil. Symptoms are most evident when air temperatures are cool (42° to 60° F.). It has been reported that heads affected with big vein stored as well as disease-free lettuce. Control recommendations include crop rotation and soil fumigation (steaming, formaldehyde, chloropicrin, and other chemicals).

MOSAIC. Mosaic occurs throughout the United States. It has caused serious losses by reduction in yield and quality in some seasons in Arizona and California. Plants attacked when young may fail to head. When attacked at the heading stage, a mild mottling, often on one side of the head, may result. The heads may be irregular in shape, and leaves may show a vein clearing as well as a necrotic flecking which resembles somewhat spotted wilt and russet spotting. In storage mosaic-infected lettuce shows a progressive marginal browning and decay and has a shorter storage life than virus-free lettuce. In some cases the amount of disease has been correlated with the aphid population and with temperatures about 10° above normal. Mosaic is caused by several distinct viruses. The common type is seed-borne and transmitted by aphids. All commercial varieties of head lettuce are susceptible. Parris Island cos lettuce is said to be resistant. The use of mosaic-free seed and aphid control is recommended to reduce mosaic.

SPOTTED WILT. Spotted wilt occurs in several lettuce producing areas of the United States as well as many foreign countries. It may be very destructive some seasons in the coastal regions of California. Lettuce attacked in later stages of growth usually produces heads, although these may be unmarketable. In late infections brown, necrotic, pitted spots or streaks are formed. These are usually most evident along the midribs near the base of the head (pl. 6, *A* and *B*). Symptoms may occur on the inner as well as the outer head leaves. Usually one side of the plant is more affected than the other. This

may cause unequal growth, resulting in a decided curvature of the petioles of diseased leaves (pl. 6, *C*). Plants affected late in growth, after heading, often show no external evidence of spotted wilt, and it is only after the outer leaves are removed that the brown, necrotic spots are seen. On eastern terminal markets it is not ordinarily possible to separate heads affected by spotted wilt from those with other types of russet spotting. Bacterial soft rot frequently follows spotted wilt.

Spotted wilt is caused by a virus that is transmitted by several species of thrips. The disease attacks all commercial varieties of head lettuce, although the Mignonette variety is reported to escape infections in the field. Spotted wilt also infects endive. To reduce the amount of spotted wilt at the terminal markets, rigid grading and inspections to keep infected heads off the market, and rapid marketing is advisable to reduce the amount of secondary bacterial soft rot that may develop.

(See *8, 33, 52, 53, 69, 111, 115, 116, 134.*)

WATERY SOFT ROT (SCLEROTINIOSE)

(*Sclerotinia sclerotiorum* (Lib.) DBy. and *S. minor* Jagger)

Occurrence and Importance

Watery soft rot may cause serious losses on lettuce, endive, escarole, and witloof chicory during transit, storage and subsequent marketing. The disease also is destructive in lettuce fields where it is known as drop or wilt.

Symptoms

Watery soft rot may start any place on the head, although it usually occurs at the basal part. Affected tissues are watersoaked, light or pinkish brown, and without a characteristic odor. As infection spreads, a white cottony mold develops and the affected heads are turned into a wet, leaking mass (Pl. 5, *A*). In very advanced stages irregular, black resting bodies of the fungus called sclerotia develop on affected tissues.

Causal Factors

The fungus, *Sclerotinia sclerotiorum*, is the chief pathogen of watery soft rot, but at times another fungus, *S. minor*, may be the cause. These fungi are perpetuated from crop to crop by sclerotia either in the soil or in affected plant trash. When favorable temperature and moisture conditions prevail, the mycelium grows from the sclerotia into the soil and attacks plants of the current season's crop. The pathogen is also spread by means of innumerable spores that are discharged from little cup-shaped fruiting bodies (apothecia) that push up to the soil surface from buried sclerotia.

Growth of the mycelium, germination of the sclerotia, production of the apothecia, and infection of the plants occur only under moist conditions. Production and discharge of spores are favored by moderately low temperatures and prevented by those above 80° F. Each species of *Sclerotinia* grows and causes decay over a wide temperature

range. Infection may occur at temperatures as low as 32° to 34° and as high as 82°. A range of approximately 70° to 78° is most favorable.

The presence of fresh wounds, although not essential for entrance of the pathogen, favors infection. When temperatures become high during transit or packages are held unusually long on the market or in storage the fungus may spread from head to head.

Control Measures

Measures which reduce watery soft rot on the market include careful trimming of diseased outer leaves, rigid grading and inspection at shipping point, rapid precooling, shipment at temperatures close to 32° F, nd rapid marketing.

(See *54*, *92*, *110*.)

RHUBARB

Rhubarb (*Rheum rhaponticum* L.), sometimes called pieplant, is grown for its thick, fleshy leafstalks. The marketability of these deends largely upon tenderness and crispness, which are a matter of ge, and upon freedom from blemishes and decay. There are a few liseases which affect the leaves of the plant in the field and some that ttack the leafstalk directly. Anthracnose, crown and foot rots, and tem spot which affect the leafstalks are sometimes damaging on the narket. Gray mold rot is the most important market disease of hubarb.

ANTHRACNOSE

(*Colletotrichum erumpens* Sacc.)

Anthracnose has been found on rhubarb in the field in several localiies and on the market, where it is especially damaging because the esions detract from the appearance of the product and sometimes pen the way for secondary decay-producing organisms.

Anthracnose is characterized by soft, watery, translucent spots on ne leafstalks, which are the only part of the plant affected. The esions are usually oval in outline, with the long axis lengthwise of the alk. When a lesion attains a diameter of about one-half inch very nall, black specks (spore-producing acervuli) appear in great numers in the center of the spot. In advanced stages the whole stalk is ft and rotten and covered with acervuli. This complete decay is ost often found in old, wilted stalks in the fields. Only the small ots which escape the notice of the packer are found on the market.

The pathogen produces innumerable spores in the acervuli. These ores are spattered by raindrops or are carried by insects from one alk to another. In moist, rather warm weather infection and deelopment of decay may take place in a short time. Wounds are not ecessary for infection; consequently there is a possibility of the disse spreading by contact if infected stalks are packed with healthy nes.

No control methods have been developed.

(See *109*.)

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GRAY MOLD ROT

(*Botrytis* sp.)

Gray mold rot is the most serious transit and market disease of rhubarb. Although the causal fungus is practically ever present wherever this crop is grown, it seldom affects vigorously growing plants in the field. However, injured plants and old leaves become infected readily under humid conditions. The causal fungus produces great numbers of spores, which contaminate the leafstalks during harvesting and packing.

On the market gray mold rot in the early stage appears as small red spots on the sides of the leafstalk and as water-soaked brown areas at the base of the stalk or in injured tissues elsewhere (pl. 7, *B*). At this stage no mycelium or spores are visible. Decay lesions enlarge rapidly, soon involving large portions of the stalk. Grayish, smoke-colored mycelium and grayish-brown, granular masses of spores on the larger lesions are characteristic signs of this disease. Most infections take place at the bases of the leafstalks where wounds are made in harvesting, but they may also occur in apparently normal tissue.

Refrigeration temperatures near 32° F. will retard but not stop the development of gray mold rot during transit.

(See also Globe Artichokes, Gray Mold Rot, p. 4.)

PHYTOPHTHORA ROTS (FOOT AND CROWN ROTS)

(*Phytophthora* spp.)

Occurrence and Importance

In all regions where rhubarb is grown commercially apparently one or more species of *Phytophthora* may cause serious diseases. Although different organisms are involved as causal agents the disease symptoms are very similar and for practical purposes may be considered as characterizing one disease.

The phytophthora diseases, often referred to as foot and crown rots, are primarily field troubles, but occasionally infected stalks reach the markets. Bacterial soft rot follows these rots so closely that by the time diseased stalks reach the market the former appears to be the more important decay. For this reason these two diseases often have been confused on the market.

Symptoms

Phytophthora rots are characterized by watery, greenish-brown, sunken lesions that start at the base of the leafstalk and progress rapidly throughout the stalk causing a brown decay. Secondary bacterial infections usually cause rapid decomposition of affected stalks.

Causal Factors

The pathogens responsible for most of the foot and crown rots of rhubarb are *Phytophthora parasitica* Dast. and *P. cactorum* (Leb. and Cohn) Schroet. However, a closely related fungus, *Pythium ultimum*, and other species of Pythium have also been found to cause

stalk rots in some localities. All these fungi produce swimming spores (zoospores), and for this reason the severity of infection is directly correlated with the amount of rainfall. Warm, wet weather is especially favorable for the development of rot caused by *Phytophthora parasitica*, since it grows best at about 86° F. The minimum temperature for growth of this fungus is 55° and the maximum 97°. *P. cactorum*, is more likely on rhubarb grown farther north or during cool, wet seasons. Its minimum temperature for growth is 43°, optimum 77°, and maximum 92°.

Infections by any of these organisms may take place in uninjured as well as injured stalks.

Control Measures

Although no data are available regarding the development of decay during transit, the possibility of such decay occurring makes it undesirable to pack for shipment any rhubarb showing any evidence of infection. Transit and storage temperatures below 40° F. will retard development of this decay.

(See *6, 32, 78.*)

STEM SPOT (LEAF SPOT)

(*Phyllosticta straminella* Bres.)

This stem and leaf spot disease is sometimes of market importance on Illinois and California rhubarb. This disease causes small, greenish-yellow spots on the upper surfaces of the leaves which enlarge and become tan, with wine-red borders as they get older. Eventually portions of the dead tissues drop out, leaving ragged holes. When the stems are infected the most serious loss generally occurs in the first cuttings. Spots on stems are small, oval to oblong and reddish-brown (pl. 7, *A*). With age some of these may become elongated and extend one-half inch or more lengthwise of the stem. Small, black fruiting bodies (pycnidia) which serve to identify this disease eventually appear in the dead tissue of both the leaf and stem spots. *Botrytis*, *Rhizopus*, *Cladosporium*, and *Penicillium* sometimes invade stem spot lesions.

Infection may occur through healthy, uninjured tissue wherever the fungus comes in contact with moist stems. However, the lesions develop so slowly that no new spots are likely to develop during transit.

Losses in transit and marketing may be reduced by not shipping spotted rhubarb and by keeping the temperature near 32° F.

(See *101, 109*).

SPINACH

Spinach is harvested and shipped to market as leaves and crown (crown-cut) or as leaves (clip-cut or clipped) of the plant (*Spinacia oleracea* L.). A high percentage of fresh spinach is now washed, prepackaged for marketing, and for this purpose clip-cut spinach is preferred. For the fresh market savoy-leaved varieties, as Dark Green Bloomsdale, Long Standing Bloomsdale, Virginia Savoy, and Old Dominion, are used. The frozen and canning spinach industries prefer smooth-leaved varieties like Nobel, King of Denmark, Viroflay,

Hollandia, and Dark Green Prickly Seeded. Quality spinach should be of a good green color, fresh, crisp, and free from blemishes and decay.

The more important field diseases of spinach are anthracnose (*Colletotrichum spinaciae* Ell. and Halst.), bacterial soft rot, damping-off (*Pythium* spp., *Phytophthora* spp. and *Pellicularia filamentosa* (Pat.) Rogers), downy mildew, heterosporium leaf spot, other leaf-spots (*Alternaria* sp., *Cercospora* spp., *Cladosporium* spp. and *Phyllosticta chenopodii* Sau.), orange rust, white rust, wilt (*Fusarium* spp.), and several virus diseases (aster yellows, beet mosaic, cucumber mosaic also called blight or yellows, curly top, spotted wilt, and yellow dwarf). In areas where air pollution is great, spinach may be severely injured in the field by air-borne chemicals. Nutritional diseases often characterized by leaf chlorosis are caused by the unavailability or deficiencies of magnesium, boron, and manganese.

On the market bacterial soft rot, downy mildew, and white rust are most frequently observed. Orange rust and heterosporium leaf spot also occur occasionally.

Damage to the young leaves in the center of the plant caused by feeding of the larvae of the seed-corn maggot (*Hylemya cilicrura* (Rond.)), the so-called budworm injury, and the holes made on the older leaves by feeding of the spotted cucumber beetle (*Diabrotica duodecimpunctata* (F.)) constitute important insect injuries noted on the market. Aphids on fresh spinach (either alive or killed by fungus) are occasionally a problem in the canning and frozen industries and in the prepackaging of fresh spinach on the terminal markets.

(See *7, 29, 79, 89, 120*.)

BACTERIAL SOFT ROT

(*Erwinia carotovora* (Jones) Holland and other organisms)

Occurrence and Importance

Bacterial soft rot is by far the most important disease of fresh spinach on the market. With the advent of prepackaged spinach the seriousness of this decay has increased.

Symptoms

Affected tissues are water-soaked, muddy green, or greasy in appearance (pl. 8, *C*). Rapid softening and disintegration follow so that the decayed tissues soon become wet and mushy and eventually have a putrid odor. In dry air the decay may be checked and the affected tissues become dry and brittle.

Causal Factors

Bacterial soft rot of vegetables is caused by *Erwinia carotovora* and other bacteria. These microorganisms are common in soils and plant debris. The market product becomes contaminated with the soft rot bacteria while in the field or during harvesting and packing. Infection almost always takes place through mechanical injuries, insect punctures, disease lesions, or other skin breaks.

A combination of high humidity and high temperatures is ideal for the development and spread of bacterial soft rot. The most favorable temperature range is approximately 77° to 86° F. Frequently the decay is more important at somewhat lower temperatures (69° to 77°), because there is less drying-out than at the higher temperatures. The decay is checked considerably, but not entirely, by temperatures of about 40° to 45°.

Control Measures

The control of transit and marketing losses caused by bacterial soft rot consists very largely in rapid precooling to remove field heat, the maintenance of low temperatures during transit and marketing, and the movement of spinach rapidly in the marketing channels. Removal of excess water from washed spinach prior to prepackaging, rapid precooling (especially by vacuum cooling) and the use of ice bags are recommended for prepackaged spinach. Although not presently permitted, experimental preharvest and post-harvest treatments with antibiotics have retarded decay of prepackaged spinach. Shipping fresh, high-quality spinach that is as free as possible from disease lesions, as well as reduction in the crushing and bruising of the harvested product, will do much to reduce losses from bacterial soft rot.

(See *10, 23, 25, 28, 96, 102, 107.*)

DOWNY MILDEW

(*Peronospora effusa* (Grev. ex Desm.) Ces.

Occurrence and Importance

Downy mildew is found in all commercial spinach-growing areas. Significant field losses occur regularly, especially in the coastal areas. During cool, rainy weather the disease may be so serious that fields are left unharvested. On the market downy mildew is an important disease because the leaf spotting detracts from the appearance and quality of spinach, and the leaf lesions may open the way for secondary soft rot bacteria.

Symptoms

The appearance of pale-yellow areas in the normal green of the leaf usually constitutes the first symptom of the disease (pl. 8, *A*). These areas or spots are irregular in shape, are without clearly defined margins, and vary considerably in size. They are apparent on both upper and lower leaf surfaces. Under humid conditions the fungus develops over the surface of the infected areas on the lower side of the leaf as a whitish-gray mold that soon turns lilac-gray or purple-gray (pl. 8, *B*). Under very low relative humidity, yellowing may occur without any signs of the mold appearing, while under high humidity the downy mildew may develop before there is any evidence of yellowing and may even be found fruiting on the upper leaf surfaces and the petioles. Severely infected leaves may dry up or under wet conditions become water-soaked and brownish and soon decay.

There is evidence that new spots may appear and old ones become more prominent during transit and marketing.

Causal Factors

The pathogen, *Peronospora effusa*, is one of the downy mildew fungi and can grow and reproduce only while associated with living tissue. It attacks only spinach. The mold reproduces primarily by means of conidia, or summer spores, which form in great abundance under humid conditions (relative humidity of 85 percent or above) and are spread by wind and rain. It is the presence of conidia and the conidiophores on which they are borne that gives the mildew the purplish-gray color.

Moisture on the leaf is necessary for germination of the conidia and infection. Mildew is likely to be important following periods of fog or heavy dews and a temperature range of about 40° to 75° F. At about 60° to 65° infection of spinach leaves may occur within 3 hours after they are inoculated. Fruiting of the fungus on these new lesions may take place 6 days after inoculation.

Oospores, or resting spores, which are produced in diseased leaf tissue may be the means by which the fungus over-winters or over-summers in the soil or possibly on contaminated seed. The fungus also may exist in mild climates on volunteer spinach plants.

Control Measures

At the present time the recently developed variety Califlay is the only resistant variety of spinach available commercially. Losses in transit and marketing may be reduced by not packing mildew affected spinach and keeping the temperature near 32° F.

(See *2, 12, 89, 103, 105, 131.*)

HETEROSPORIUM LEAF SPOT

(*Heterosporium variabile* Cke.)

Heterosporium leaf spot, also called pin head rust, although widely distributed is ordinarily a minor disease. At times, however, it may become destructive. The causal fungus is usually considered to be only weakly pathogenic and to attack plants weakened as a result of unfavorable environmental conditions or other disease. On the market it is occasionally found as a leaf blemish of Virginia or Texas spinach, especially late in the season.

The leaf spots are usually numerous, roughly circular, light brown and slightly depressed (pl. 9, *C*). The lesions may have sharply defined brown to purple borders and are evident on both the upper and lower leaf surfaces. The fungus forms an abundant olive-green to black velvety layer of sporulating mold on the older spots on both leaf surfaces. Where spots are numerous they coalesce and the adjacent unaffected areas of the leaf may become yellowed and then turn brown. Spots are most abundant on the older leaves. With the return of climatic conditions more favorable for spinach growth the newly developed leaves may be free of leaf spots.

Market losses may be reduced by not shipping spinach from obviously affected crops.

(See *31, 60, 120.*)

ORANGE RUST

(*Puccinia aristidae* Tracy)

Orange rust is ordinarily a minor disease. It was of economic nportance in 1922 in the Northwest and in 1944 and 1952 in Colorado vhen some fields were plowed up because severe leaf spotting made he spinach unsalable.

The first visible lesions are very small and appear chiefly as light 'ellow spots on the underside of leaves. Such spots are difficult to see nd may be unknowingly packed. As the lesions enlarge and the 'ruiting bodies (sori) begin to develop the color changes rapidly from ight yellow to orange and the lesions become conspicuous (pl. 8, *D*). t has been reported that once infections occur the rust spots become onspicuous rapidly and fields of spinach often become worthless vithin a few days. Rust spots may enlarge in transit and during narketing.

The rust fungus spreads from wild salt grass (*Distichlis stricta*) to pinach. Orange rust attacks both flat and curly types of spinach. Outbreaks of the disease have been associated with cool, wet, spring 'eather, and have ceased when the weather turned warm and dry.

Destruction of wild salt grass might reduce field infections of range rust on spinach. Rapid precooling to temperatures below 0° F. may prevent enlargement of lesions during transit and narketing.

(See *93*, *94*.)

WHITE RUST

(*Albugo occidentalis* G. W. Wils.)

White rust causes serious field losses in some seasons in Texas, klahoma, and Louisiana. The disease also has been reported in rkansas and Virginia. On the market white rust is at times an nportant disease of Texas-grown spinach.

The fungus develops within the leaf tissues and later produces on e lower leaf surface numerous, tiny, blisterlike pustules (sori) which e filled with whitish masses of spores (pl. 9, *A* and *B*). Sometimes e pustules may have a concentrically zonate pattern. Accompany- g the white pustules is a slight yellowing of the adjacent tissues at is apparent on both leaf surfaces. The yellowed areas are in- finite in outline and when seen from the upper surface are some- hat similar to those caused by downy mildew. White rust usually pears first near the borders of the outermost leaves of the plant. ter the lower surfaces of all leaves may bear a few to many sori. casionally, sori may develop on the upper leaf surface, branches, d petioles. At times, resting spores (oospores) develop and give a ackish appearance to affected tissues. Sometimes there is a yellow- g and mosaic-like discoloration of affected leaves without the forma- n of sori. Leaves that are severely infected may show brown, crotic spots and the entire leaf may later turn brown.

The disease is favored by periods of clear, relatively warm, dry days h cool nights. The fungus apparently overwinters in the soil.

Some weeds are attacked by the white rust fungus but spinach is the only commercial crop affected.

It has been recommended that the crop residue be removed immediately after harvest to prevent oospore development in unharvested plants. Some flat-leaved canning varieties like Viroflay, King of Denmark and others are rust-resistant.

(See *2*, *85*, *89*, *90*, *127*, *133*.)

SWEETPOTATOES

The sweetpotato of commerce consists of the thickened roots of the sweetpotato plant (*Ipomoea batatas* (L.) Lam.). There are a number of varieties used for food in the United States. Regardless of variety the roots should be firm, smooth, well-shaped, and free from blemishes and decay.

Many diseases which attack plants in the field not only lead to reduction in yield but also may affect the quality of the crop by causing production of poorly shaped, rough, or blemished potatoes. Some of the diseases which affect the growing plants also cause blemishes and decay of the roots during storage and marketing. Other diseases affect sweetpotatoes only after they have been harvested.

The most important diseases which affect the growing plant are black rot, foot rot, mottle necrosis, Texas root rot (*Phymatotrichum omnivorum* (Shear) Dugg.), soil rot, and stem rot or wilt. Scurf and rhizoctonia rot (*Pellicularia filamentosa* (Pat.) Rogers) affect the skin of the roots, making them unsightly and impairing their keeping qualities.

The following diseases lead to losses of sweetpotatoes in storage and on the market by causing blemishes and decay: Alternaria rot (*Alternaria* sp.), black rot, blue mold rot, charcoal rot, dry rot, epicoccum rot (*Epicoccum* sp.), end rots, foot rot, gray mold rot, Java black rot, mucor rot, rhizopus soft rot, sclerotinia rot, (*Sclerotinia sclerotiorum* (Lib.) DBy.), scurf, soil rot, surface rot, and trichoderma rot (*Trichoderma koningi* Oud.). Many of the storage diseases are less serious if sweetpotatoes are cured for 4 to 5 days at 84° F. and a relative humidity of 85 to 90 per cent and subsequently stored at 55° and a relative humidity of 85 per cent.

The most important nonparasitic troubles are bruising injury, chilling injury, freezing injury, growth cracks, and internal breakdown.

(See *4*, *15*, *17*, *18*, *21*, *41*, *42*, *58*, *64*, *72*, *73*, *122*, *123*, *126*.)

BLACK ROT

(*Endoconidiophora fimbriata* (Ell. and Halst.) Davidson)

Occurrence and Importance

Black rot is one of the most serious and most widely distributed diseases of sweetpotatoes. Although it injures the plants in the seed bed and in the field, most damage is caused in storage and during marketing. Next to rhizopus soft rot it is the most serious market disease of sweetpotatoes.

Symptoms

The early stages of black rot appear as circular, brown, slightly sunken, superficial spots about one-fourth inch in diameter. As these spots enlarge (½ inch to 2 inches) they become black to greenish black and frequently show small, black fruiting bodies (perithecia) with long necks, which appear to the naked eye as black bristles (pl. 10). Even in advanced stages the rot is firm and generally shallow, rarely penetrating to the center of the root. The internal tissues are black or greenish black. The diseased tissues are very bitter, and the entire root when cooked has a bitter flavor.

Causal Factors

The causal fungus (*Endoconidiophora fimbriata*) is carried over from season to season in roots, plant debris, and soil. Disease devel-opment in the field is favored by wet soil and moderately high tem-peratures. The fungus will grow throughout a temperature range from 50° to 95° F., but most rapid growth takes place at about 77°. Sweetpotatoes may become infected through wounds, dead rootlets, or apparently uninjured tissues. The number of infections is influ-enced by the soil moisture and temperature conditions previous to and during harvesting. Although the obviously infected potatoes are discarded at storage time, some potatoes will have spots too small to be detected. Under storage conditions these small spots may enlarge to about 1 inch in diameter within 4 to 6 weeks. This is usually the explanation for rather high percentages of black rot appearing in sweetpotatoes that were thought to be free from decay when they were stored. Especially severe infection occurs when healthy sweet-potatoes are washed in the same water with those affected with black rot.

Control Measures

Control in storage involves careful handling and discarding of all visibly infected sweetpotatoes previous to storing. Those that are harvested from soils known to be infested should be kept separate from those grown in disease-free fields. For recommended curing and storage conditions, see page 25. A heat-treatment at 105°–110° F. for 24 hours will prevent the development of black rot. Sweetpotato lots in which any black rot has been found should not be washed, since this may spread the disease to sound roots.

(See *16*, *44*, *45*, *56*, *62*, *104*, *112*.)

BLUE MOLD ROT

(*Penicillium* sp.)

Blue mold rot is most often found in sweetpotatoes that have been chilled or frozen. Potatoes that have been stored at low temperature and moderately high humidity are particularly susceptible.

The spores of the causal fungus are ever present in the air and on the surface of most fruits and vegetables, but they are unable to cause infection except through wounds or through tissues broken down by other agencies.

Blue mold rot is a soft decay generally involving large areas about mechanical injuries or lesions of other diseases. In chilled or frozen sweetpotatoes the whole root is soon decayed and the characteristic white and blue-green tufts of mold break through the epidermis. These colored tufts are the most reliable diagnostic character. When many potatoes are infected, the whole lot has a musty odor.

This disease may be avoided if care is used to prevent chilling, mechanical injuries, and if proper temperature and humidity are maintained (p. 25). It is especially important that a combination of low temperatures and high humidity be avoided.

(See *41*, *63*.)

CHARCOAL ROT

(*Macrophomina phaseoli* (Maub.) Ashby)

Charcoal rot is most important as a storage disease of sweetpotatoes grown in the South, but occurs wherever sweetpotatoes are grown. It sometimes causes injury to growing plants in the field when the stem becomes infected at the soil line. Decay most often starts at the upper end of the sweetpotatoes and progresses throughout its length from that point. In the early stages charcoal rot is characterized by a light brown discoloration of the surface as well as of the internal tissues. The discolored areas may be of any size or shape, but there is a sharp line of demarcation between the diseased and healthy tissues (pl. 11, *C*). As the decay progresses, the affected regions remain firm and become dark brown. The skin later begins to shrivel as water is lost by evaporation. In the final stages of this disease the root is converted into a hard, dry, black mummy.

When a decaying potato is cut there are usually three rather distinct color zones in the affected tissues. The margin or advancing edge of the decay is light or cinnamon brown and slightly spongy in texture, the intermediate zone is reddish brown and firm, and the oldest part of the lesion (end of sweetpotato or center of decayed spot) is grayish black to black, dry, and firm (pl. 11, *B*). On close examination of the grayish-black region very small, black, specklike sclerotia may be seen within the tissues (pl. 11, *A* and *B*). No sclerotia or fungus filaments are visible on the surface of diseased sweetpotatoes.

Experimental evidence indicates that the minimum temperature for growth of the causal organism is near 46° F., the optimum 88°, and the maximum 108°.

This disease progresses slowly at recommended storage temperatures. Charcoal rot develops rapidly in freshly harvested stock having slight infections at the ends of the roots that are sent directly to market. By the time some shipments of new stock reach the market as many as 50 per cent of the sweetpotatoes show charcoal rot.

Losses from charcoal rot may be reduced by not storing or shipping sweetpotatoes that show even the slightest decay at the ends at harvesttime.

Prompt curing under optimum temperature and humidity conditions favors rapid wound-cork formation and thus prevents new infections.

(See *41*, *112*.)

CHILLING INJURY (LOW-TEMPERATURE BREAK-DOWN)

The sweetpotato is subject to chilling injury when stored for some time (10 days or longer) at temperatures below 55° F. This low-temperature break-down is brought about by physiologic changes that occur at these temperatures. The chief symptom is a brown to slightly black internal discoloration consisting of scattered areas and specks associated with the vascular ring and with the vascular elements in the central part of the sweetpotato. Flavor is also adversely affected.

Storage under conditions conducive to chilling injury makes sweetpotatoes particularly subject to spoilage by a number of different rots including mucor rot, blue mold rot, and gray mold rot. These often cause serious loss within 3 to 6 weeks when sweetpotatoes are stored at temperatures below 45° F.

The danger from chilling and from the associated decays make it hazardous to expose sweetpotatoes to temperatures below about 55° F.

(See *41*, *55*, *63*, *71*.)

DRY ROT

(*Diaporthe batatatis* (Ell. and Halst.) Harter and Field)

Most losses from dry rot occur during storage and marketing. The disease is widely distributed but seldom causes serious trouble on sweetpotatoes in the field. From infections on slips in the seedbed and diseased vines in the field the causal fungus invades the potatoes at the attached ends.

Dry rot even in early stages is characteristically a dark-brown, firm decay. In practically all cases it starts at the end of the potato. As the fungus progresses, the broken-down tissues lose water quickly and withering of the affected end results. Soon the diseased area becomes black and hard. The surface of such areas is soon covered with black pimplelike elevations, the fruiting bodies (pycnidia) of the causal fungus (pl. 12, *A*). These numerous black pimples in and underneath the skin of a sweetpotato showing a dry, hard, black decay generally serve to identify this disease.

Dry rot does not develop as rapidly or cause as much loss as black rot, but inoculation experiments show that infected sweetpotatoes may be completely rotted within about 6 weeks at the usual storage temperatures.

No definite control methods have been worked out. Prompt curing under optimum temperature and humidity conditions favor rapid wound-cork formation and would probably prevent infections after harvest.

(See *37*.)

END ROTS

(*Fusarium* spp.)

Although end rots may be caused by a number of different organisms that under special conditions attack sweetpotatoes, most of those encountered on the market are caused by various species of *Fusarium*. They commonly invade the sweetpotato through wounds and through tissues that are broken down by other agencies. Consequently these

fusarium end rots frequently show a wide variety of symptoms. The most serious type found on the market is a firm, dry rot characterized by a withering of the ends of the sweetpotatoes (pl. 12, *B*). In Maryland the Dry Rot fungus (*Diaporthe*) alone or in conjunction with *Fusarium* causes a serious end rot.

Since infection occurs at injuries, losses in storage may be reduced by prompt curing under optimum temperature and humidity conditions to promote rapid healing of wounds made during harvesting.

(See *130*.)

FOOT ROT

(*Plenodomus destruens* Harter)

Foot rot of sweetpotatoes is an important storage and market trouble. Sometimes it is also important as a field disease. It has been found to be widely distributed, but it usually causes less damage than black rot. Infected sweetpotatoes from diseased vines carry the fungus into the storage houses where decay progresses, often causing serious loss.

In storage and on the market foot rot appears as a firm to spongy, dark-brown decay with evident shriveling of the affected tissues (pl. 13, *A*). Most lesions soon show numerous dark-brown fruiting bodies (pycnidia) in the skin of the sweetpotato near the end. Practically all infections take place at the attached end of the sweetpotatoes during the growing season, but infections have been observed to occur in wounds made at harvesttime.

At digging time the decay is often so slight as to make it impossible to sort out all diseased sweetpotatoes before they are stored. It is such mildly infected sweetpotatoes that cause trouble in storage and transit.

Foot rot is a slowly developing decay favored by temperatures between 68° to 86° F. Little growth of the fungus occurs below 54° or above 98°.

Sweetpotatoes showing evident decay should not be stored or shipped to distant markets.

(See *35*, *113*.)

FREEZING INJURY

Although the sweetpotato is generally believed to be one of the vegetables most susceptible to low temperature injury, the average freezing temperature (29° F.) is lower than for many vegetables that are more hardy. However, the indirect effects of low temperatures in causing internal discoloration and in favoring the development of decay by certain fungi make it necessary to look with suspicion upon any lot of sweetpotatoes that has been exposed to temperatures below 50° for any great length of time. (See also Chilling Injury, p. —) Sweetpotatoes that have been only slightly frozen are characterized by yellowish-brown discoloration in the vascular ring and internal vascular elements and by a yellowish-green water-soaked appearance of the other tissues (pl. 14, *A*). When exposure to freezing temperature has been so prolonged that ice has formed within the tissues, they collapse immediately upon thawing and the sweetpotato becomes soft and flabby as water is liberated. Roots so affected may dry and be

come brown, discolored mummies, although usually they become de-
cayed by blue mold.

(See *98*, *132*.)

GRAY MOLD ROT

(*Botrytis* sp.)

Gray mold rot is a minor storage and transit disease, which attacks weetpotatoes at low temperatures and high humidities. Infection akes place at the ends of the sweetpotatoes or through wounds else-here. Decayed tissues are moderately soft and grayish brown and ave a starchy odor. The causal fungus can grow well over a wide emperature range, but it usually causes most damage at moderately ow temperatures. At the usual storage temperatures this fungus may ompletely decay infected sweetpotatoes within 2 weeks.

(See also Globe Artichokes, Gray Mold Rot, p. 4.) (See *63*.)

GROWTH CRACKS

A severe blemish of sweetpotatoes sometimes occurs in the form of oderately deep lengthwise and crosswise fissures commonly called rowth cracks (pl. 18, *C*). Apparently any weather or soil condition at causes irregular or interrupted development of the sweetpotatoes ay lead to this cracking. Thus a period of rapid growth due to vorable moisture conditions following drought may result in the velopment of the trouble. In some regions it has been noted that e application to the soil of high-nitrogen fertilizers or stable manure nds to induce growth cracks.

Experimental tests have shown that some varieties of sweetpotatoes e much more likely to produce growth cracks than others. The uthern Queen was found particularly susceptible.

Most growth cracks heal without becoming infected, but occasionally eetpotatoes have been found on the market with fusarium rot and ick rot following the cracks.

(See *41*.)

INTERNAL BREAK-DOWN

Sweetpotatoes in storage sometimes develop a breakdown of the in-nal tissues; in advanced cases affected specimens can be detected by ir light weight and spongy feeling. When such potatoes are cut s seen that the internal tissues are pithy or dry and spongy, with ities forming in the central parts of the roots as the tissues sepa-e (pl. 14, *C*). At times the spongy tissues are white or light yellow l of a cottony texture.

nternal breakdown is usually found late in the storage season and nost prevalent in storages that have been kept warm and too dry l in storages where slight chilling injury has occurred.

See 17, 39, 41.)

INTERNAL CORK

nternal cork is a virus disease of sweetpotatoes characterized by occurrence of dark brown to black, hard, corky spots of irregular and shape in the flesh of the roots (pl. 15). This disease was first

recognized in South Carolina and has now spread to all States that grow sweetpotatoes commercially.

Occasionally a surface depression indicates the presence of a corky area just underneath the skin but usually the disease cannot be detected without slicing through the sweetpotato. The hard corky spots are sharply outlined and the surrounding healthy flesh shows no sign of deterioration or decay. The spots remain hard and gritty even after cooking, but neither the color, flavor nor texture of the surrounding flesh is affected. Sweetpotatoes showing very little spotting at harvesttime may show a considerable increase in spotting at the end of 4 to 6 months' storage. Some experimental evidence indicates a possible increase from 10 percent at harvesttime to 100 percent after six months' storage at 75° F. The rate of increase is much more rapid at 70° to 75° than at the recommended storage temperature of 55°. Among different varieties of sweetpotatoes the expression of symptoms are quite variable. The popular Puerto Rico is the most severely spotted variety in the Southeastern states.

Sweetpotatoes suspected of being infected with internal cork should be marketed soon after harvest, before the corky areas develop sufficiently to make the sweetpotatoes undesirable. If stored the temperature should be kept near 55° F. to retard development of the disease.

(See *5, 14, 50, 57, 76, 81, 95, 128.*)

JAVA BLACK ROT

(*Diplodia tubericola* (Ell. and Ev.) Taub)

Occurrence and Importance

Java black rot does not attack sweetpotatoes until after they are harvested and is of economic importance only from the storage and market point of view. Although it is a slowly developing rot, it nevertheless causes heavy losses because of its wide distribution, which is probably coextensive with the sweetpotato itself. It can be found in practically every sweetpotato storage house and in storage banks. Losses from Java black rot are, however, usually more severe in the southern part of the United States and in the tropics than in the northern sweetpotato section.

Symptoms

It takes about 10 days after infection before symptoms of the decay appear and a month or more before the sweetpotato is completely decayed. The decay in the early stages is brown and moderately firm. As the tissues throughout the sweetpotato (pl. 16, *B*) become involved, the central part is light brown and the skin and tissues just beneath change from dark brown to black as fruiting bodies (pycnidia) form within. Scattered slightly raised pimples indicate the development of pycnidia which are pushing up under and through the skin (pl. 16, *A*). In 3 or 4 weeks these fruiting bodies form in great numbers and are often so crowded as to form domelike elevations of the surface. Eventually the sweetpotato becomes a hard, dry, black mummy (pl. 16, *C*).

Causal Factors

The pathogen (*Diplodia tubericola*), like others of its close rela-
ives, occurs in the soil, on sweetpotatoes and other plants, and in
lant debris. No infection appears to take place in the field except
hrough wounds at digging time and during handling for storage
nd marketing. The organism may be carried into storage on roots,
nd it may be present there in old roots or in debris. Infections
rough wounds have been obtained throughout a temperature range
f 54° to 98° F., with most rapid decay occurring between 84° and
8°.

Control Measures

Careful handling of the sweetpotatoes to avoid all unnecessary
ounds at harvest and storage time and prompt curing are valuable
ethods for controlling Java black rot.

Sweetpotatoes cured for 4 or 5 days at a relative humidity of 85 to
) per cent and a temperature of 85° F. will develop protective layers
wounds sufficient to prevent infection by the Java black rot fungus
nd many other fungi that cause serious storage rots.

See *14*, *41*, *112*.)

MOTTLE NECROSIS (RING ROT)

(*Pythium ultimum* Trow and *P. scleroteichum* Drechs.)

Mottle necrosis is sometimes important in storage after wet sea-
ns. The Yellow Jersey, Big Stem Jersey, and Triumph varieties
ually are the most severely affected. Sweetpotatoes showing mottle
crosis are occasionally found on the markets in stock shipped di-
tly after harvesting, but this disease is seldom found in sweet-
tatoes shipped from storage. Apparently the infected sweet-
tatoes that go into storage decay within a few weeks and are dis-
ded before they are marketed (pl. 17, *A*). Sweetpotatoes inocu-
ed through wounds and held at moderate temperatures in high
midity have been found to develop pronounced decay within 36 to
hours and to rot completely in 3 to 7 days. The causal organisms
common soil inhabitants that thrive particularly well in wet
ls that contain an ample supply of organic matter.

n the early stages decay following natural infection of sweet-
atoes in the field consists of small, sunken, grayish-brown spots
l areas about the point of attachment of the secondary roots.
netimes the causal fungus penetrates deeply within the sweet-
ato without much surface discoloration or decay. If the tempera-
e is comparatively low a soft, gray, cheesy type of decay is pro-
ed but under relatively high temperature conditions mottled and
bled grayish-brown to chocolate-colored areas and pockets are
ned throughout the sweetpotato (pl. 17, *B* and *C*). A third type
lecay, known as ring rot, is sometimes produced. In this case the
yish-brown surface decay spreads in a band around the circum-
nce of the sweetpotato (pl. 17, *D*). Under the usual curing and
age conditions these bands or rings of diseased tissues soon become
and sunken. This dry, sunken ring rot stage is somewhat like a
e of ring rot caused by *Rhizopus* (p. 30).

Pythium ultimum, the most common of the causal organisms, grows well at moderately low temperatures. In experimental work it has been found that the minimum temperature at which infection will take place is near 36° F., the optimum between 54° and 60°, and the maximum about 95°. This temperature relation indicates that under the usual warm temperatures prevailing in the South, mottle necrosis should not ordinarily prove serious.

Infections at harvesttime may be avoided to some degree if the sweetpotatoes are harvested during dry weather.

(See *22*, *46*, *88*.)

MUCOR ROT

(*Mucor racemosus* Fres.)

Mucor rot is a storage and transit rot that occurs in sweetpotatoes only when they are exposed to high humidity at low temperatures. Consequently it is of minor importance in good storage houses because the temperature is maintained too high for its development. During transit and marketing, sweetpotatoes sometimes become moist and are exposed to temperatures between 35° and 45° F. Under such conditions this rot may develop.

Most of the infection by *Mucor* occurs through wounds at the ends or sides of the sweetpotatoes and through dead rootlets. The affected tissues are moist and clayish white and have a distinct starchy odor at first. Later they become firm to spongy and, when broken, the diseased tissues pull out in a fibrous, stringy manner.

Mucor rot is often confused with rhizopus soft rot because the causal fungi not only look alike but both also produce soft, watery, stringy types of decay. Although positive differentiation of these two rots is often difficult without making a microscopical study it may be assumed that a decay of this type occurring above 50° F. is rhizopus rot, and one found developing below 50° is probably mucor rot.

The causal organism is present practically everywhere in the air, soil, and water. It produces great numbers of spores in sporangia very similar to those produced by *Rhizopus*. Consequently sweetpotatoes may become contaminated with these spores during harvesting, storage, and marketing. The subsequent development of decay depends upon the availability of fresh wounds, moisture, and low temperatures, which favor infection.

The most important factors in the control of this disease are keeping the sweetpotatoes from becoming moist in storage and in transit and maintaining storage temperatures above 50° F.

(See *41*, *63*.)

RHIZOPUS SOFT ROT

(*Rhizopus nigricans* Ehr. and *R. tritici* Saito)

Occurrence and Importance

Rhizopus soft rot is the most important storage, transit, and market disease of sweetpotatoes. It occurs in stock from all sweetpotato regions and is the principal cause of loss of sweetpotatoes during

marketing and while they are in the hands of the consumer. Ordinarily this disease causes more loss on the market than all of the other sweetpotato diseases combined.

All varieties of sweetpotatoes are susceptible to rhizopus soft rot although some may show less decay than others. Handling and storing methods probably have a greater influence on the subsequent development of decay than any natural resistance due to varietal characteristics. Since infections by *Rhizopus* spp. are entirely dependent upon wounds or injuries produced by other diseases, rhizopus rot is not an important field disease but it may affect potatoes in the seedbed.

Symptoms

At moderate temperatures rhizopus soft rot develops more rapidly han any other decay. At favorable temperatures infections may ake place in fresh wounds and decay become evident in less than 24 iours. Infection occurs most frequently at the ends of the sweetootatoes but may take place through wounds anywhere. It can comletely destroy a sweetpotato within 4 to 6 days. At first the affected issues are soft and watery, but there is little change in color. Freshly ecayed tissues when broken will, under slight pressure, yield a ellowish-brown liquid and a rather pleasant fermentation or yeasty dor. With age the decaying tissues become cinnamon to light choclate brown in color but are never black. As water is lost by evaporaon the decayed areas become withered and firm, and under very dry nditions the sweetpotato may become a hard, brown mummy.

Although infected sweetpotatoes usually decay completely, under me circumstances only a part will rot and become dry. Side inctions through wounds sometimes progress around the sweetpotato, using the so-called ring rot stage of rhizopus soft rot. Frequently ese rings of broken-down tissue shrivel and sink, forming a dry, oovelike ring around the sweetpotato. Dry rot in rings or at the ds of sweetpotatoes may again start active decay under favorable oisture and temperature conditions.

The coarse, white, stringy mold growth, or "whiskers", with glisten- g white and black spore balls (sporangia), usually serves to identify izopus soft rot. This growth of the fungus is conspicuous at the ls and through breaks in the skin of sweetpotatoes held in a humid nosphere (pl. 18, *A*). However, under dry conditions the fungus y cause extensive decay without any surface mold (mycelium) ng visible (pl. 18, *B*).

Causal Factors

There are many species of *Rhizopus* that may cause decay of sweetatoes, but those that usually cause most serious damage are *R. ricans* and *R. tritici*. These species are ever present in the soil, er, and air. Consequently, it is safe to assume that all sweetatoes are contaminated with one or more of these fungi during vesting, storage, and marketing. Whether or not infection and y follow depends upon the moisture and temperature conditions the presence of fresh wounds on the sweetpotatoes. Surface sture or fresh moist wounds offer the most favorable conditions infection.

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The various species of *Rhizopus* that cause rot of sweetpotatoes have different reactions to temperature, but they can be divided roughly into two groups. On this basis *R. nigricans* represents the relatively low-temperature group and probably causes most decay. It develops slowly between 38° and 53° F., rapidly between 65° and 75°, and is retarded at temperatures between 86° to 94°. *R. tritici* is the most common species of the high temperature group. Its minimum temperature for growth is 40° to 48°, optimum 90° to 95°, and maximum near 107°. At temperatures between 65° and 85° either or both of these species of *Rhizopus* may be found causing decay of sweetpotatoes. The rots produced are so similar that it is impossible to distinguish them unless cultural and microscopic studies are made.

Control Measures

Since all species of *Rhizopus* commonly invade sweetpotatoes through wounds, it is of greatest importance that harvesting and handling be done as carefully as possible to avoid wounds. The less handling the better. Prompt curing of sweetpotatoes at optimum humidity and temperature facilitates the natural healing of wounds and prevents infection.

In preparing sweetpotatoes for the market, all unnecessary wounding should be avoided and care should be taken to keep them dry. Sweetpotatoes showing any evidence of decay should not be shipped. (See *19, 43, 65, 66, 67, 124*.)

ROOT KNOT

Meloidogyne spp.

Root knot caused by nematodes is a common disease of many vegetables but is considered of minor importance on sweetpotatoes. I[illegible] occurs principally in the southern States and in California. It i[illegible] generally more prevalent on sweetpotatoes grown on sandy than o[illegible] heavy soils.

Nematode infestation is characterized by the formation of galls o[illegible] rootlets, while on the fleshy roots swollen areas, scab-like abrasions o[illegible] ring-like lesions and cracks may appear (pl. 19). Inside the sweet potato small brown spots ¼ inch or less under the surface indicat[illegible] the presence of nematodes.

The nematodes live from one crop season to the next in the soil a[illegible] in sweetpotatoes in storage. The larva (eel worm) first penetrates t[illegible] growing tissue of the roots and migrates until it becomes establish[illegible] within the fleshy root. The parasite feeds within the tissue witho[illegible] killing it and in some way stimulates the cells to enlarge and divi[illegible] leading to the characteristic gall formation.

For control of root-knot of sweetpotatoes use plants that are fr[illegible] of nematodes and plant in nematode-free soil. If soil to be used f[illegible] the plant bed has been infested with nematodes fumigate it before u[illegible] For this purpose, fumigants having as the active ingredient meth[illegible] bromide, ethylene dibromide or a mixture of dichloropropene a[illegible] dichloropropane are satisfactory. Because of the differences in var[illegible] tal susceptibility it is recommended that the most tolerant varie[illegible] adapted to the locality and market concerned be selected. (See [illegible]

SCURF

(Monilochaetes infuscans Ell. and Halst.)

Scurf is one of the most common diseases of sweetpotatoes. It occurs on all varieties and appears to some extent on stock from all shipping regions. Although the causal fungus may cause a brownish discoloration of any or all of the underground parts of the growing plant, the chief damage results from a reduction in market value of the sweetpotatoes on account of their blemished appearance. Otherwise the losses in the field and in storage and marketing are of little consequence.

On marketable sweetpotatoes scurf shows as small grayish-brown spots and blotches that are only skin deep (pl. 14, *B*). These spots may be found anywhere on the sweetpotato, but usually most of them are near the attached or stem end. When numerous infections occur, the discolored spots often run together, making a continuous brown area, and in extreme cases the skin may crack. When such extensive areas of the skin are killed, the sweetpotato loses moisture rapidly and may become worthless. A few discolored spots cause no appreciable damage and are generally overlooked by the trade.

Most of the infections take place in the field, but some new infections may occur under humid storage conditions. Spots already present may enlarge slightly during storage and transit. Usually shrinkage is slow in storage unless the temperature is high and the air becomes too dry. Severely infected sweetpotatoes in hot, dry storage often crack and wither and become worthless within 4 to 6 weeks.

The causal fungus grows from infected seed sweetpotatoes to the slips, and on these it is spread to the field. Heavy soils containing an abundance of organic matter favor the development of scurf.

Losses from scurf are avoided best by field control measures such as careful selection of disease-free seed stock, use of vine or sprout cuttings instead of pulled sprouts and planting in soil that is not infested by the scurf organisms. Heavy, black, wet soils with much organic matter should be avoided if possible.

(See *13*, *36*, *82*, *83*.)

SOIL ROT (POX)

(Streptomyces ipomoea (Person and W. J. Martin) Wales & Henrici

Occurrence and Importance

Soil rot, or pox, is found in all the important sweetpotato-growing regions of the United States. Although the losses vary considerably from season to season, in many localities soil rot is considered one of the most important diseases. It seriously curtails the growth and yield of the plants and blemishes the roots so that their value is greatly reduced.

Symptoms

Sweetpotatoes that show soil rot on the market generally are characterized by dry, brown pits or pox marks, of irregular size and shape

(pl. 13, *B*). The areas infected may vary from less than ¼ inch to 1 inch in diameter. In the early stages the superficial, brown, circular spots are smooth or slightly sunken, but as they enlarge the epidermis over them cracks exposing a cavity with rough lining and irregular margin. These exposed tissues are firm and dry when found on mature roots on the market. Ordinarily they are not followed by soft rot or other secondary decays. Sometimes the root is almost girdled by these blemishes, and frequently the growth of the tissues around the deep pits results in the formation of misshaped potatoes.

Causal Factors

Within the past few years the fungus that causes soil rot has been identified as *Streptomyces ipomoea*. This organism makes very little growth at 68° F. grows best at 89°, and only slightly at 107°. The high temperatures in the southern States apparently favor the development of soil rot.

The causal organism inhabits the soil and invades the potatoes through the small secondary rootlets. Apparently most of the dissemination of this disease is through transportation of infested soil by seed potatoes, farm implements, animals, drainage water, or wind-blown dust. Experimental evidence indicates that the disease is not transmitted by the use of diseased roots for seed purposes if they have no infested soil on them.

Soil rot is most serious during dry seasons. When sufficient moisture is available the plants are able to continue growth and produce some marketable potatoes even though they are diseased.

Control Measures

If disease-free soil is not available for growing sweetpotatoes, it is possible to control soil rot in infested soil by adding sufficient sulfur to make it acid in reaction (pH 5.0).

(See *1*, *47*, *84*, *87*.)

STEM ROT (WILT)

(*Fusarium bulbigenum batatas* Wr. and *F. oxysporum* Schlecht. f. 2 Wr.

Stem rot, or wilt, is an important field disease of sweetpotatoes bu is rarely found on the market. Like other types of fusarium wilt th greatest damage is caused by the fungus invading the vascular systen of growing plants.

Sweetpotatoes produced on slightly diseased vines often develo brownish-black discolorations in the vascular rings, but no externa symptoms are evident. Consequently, affected potatoes that get int the markets are detected only upon cutting. Positive diagnosis c this disease on market potatoes is not always possible, since sweetp tatoes harvested from frosted vines or those that become chilled lat may also show dark discolorations in the vascular tissue and be co fused with wilt. This disease does not develop or spread in storag

(See *38*, *41*.)

SURFACE ROT

(*Fusarium oxysporum* Schlecht. f. 1 Wr.)

Surface rot has been reported from all sweetpotato-growing regions. [T]he amount of loss caused by this disease varies with the varieties [g]rown and with the seasonal conditions at digging time. Sometimes [p]ractically every potato is noticeably affected after 6 weeks' storage, [a]nd great losses result because of the difficulty in marketing diseased [s]tock.

The early stages of surface rot are characterized by small, circular, [li]ght-brown, superficial spots. As the disease progresses the spots [e]nlarge and become slightly sunken but change little in color. As [o]bserved on the market, most spots range from 1/4 to 3/4 inch in di[a]meter, with their margins sharply marked because of the drying [a]nd shrinking of the affected tissues (pl. 12, *C*). Even in the ad[v]anced stages the decay seldom penetrates deeper than 1/4 inch. The [fa]ct that the spots remain light brown, are definitely circular in outline, [a]nd never have any surface mold or fruiting bodies makes identifica[ti]on of the disease fairly easy.

The causal fungus lives in the soil and invades the sweetpotato [th]rough small rootlets at harvesttime and during the early part of the [st]orage period. Infection takes place most readily when potatoes [a]re harvested during wet weather; consequently, surface rot is most [se]rious in storage after wet seasons. The disease develops so slowly [th]at conspicuous lesions are not usually evident until about 6 weeks [af]ter storage. Sweetpotatoes with many lesions shrivel badly in stor[ag]e and become worthless.

Although there is a chance that new infections may occur in stor[ag]e if the sweetpotatoes do not cure promptly, it appears doubtful that [ne]w lesions would develop during storage or transit. Most surface rot [le]sions are so dry and firm that little, if any, secondary infection by [ot]her organisms occurs during transit and marketing.

Light-skinned varieties of sweetpotatoes are much more susceptible [to] surface rot than darker skinned ones. The Big Stem Jersey is [mo]re subject to injury than any other variety, but highly resistant [str]ain of Yellow Jersey has been developed.

Sweetpotatoes should not be harvested during wet weather if it can [be] avoided. Prompt curing and proper storage conditions will do [mu]ch to control the development of surface rot.

(See *19*, *40*, *61*, *77*.)

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ATE 1.—Beet disease: Black rot. A, Surface view; B, internal discoloration.

PLATE 2.—Artichoke disease: Gray mold rot. A. Internal decay; B and C,
area (B) and bracts beginning mycelium and spore masses on the decayed
to decay (C).

ATE 3.—Lettuce diseases and injuries: A, Russet spot; B, rib discoloration; C, pink rib; D, tipburn; E, tipburn followed by bacterial soft rot; F, bacterial soft rot.

PLATE 4.—Lettuce disease: Downy mildew.

E 5.—Lettuce, chicory, endive and romaine diseases and injuries: A, Watery
t rot; B, chicory watery soft rot; C, lettuce gray mold rot; D, endive
cterial soft rot; E, endive marginal browning; F, romaine marginal brown-
g.

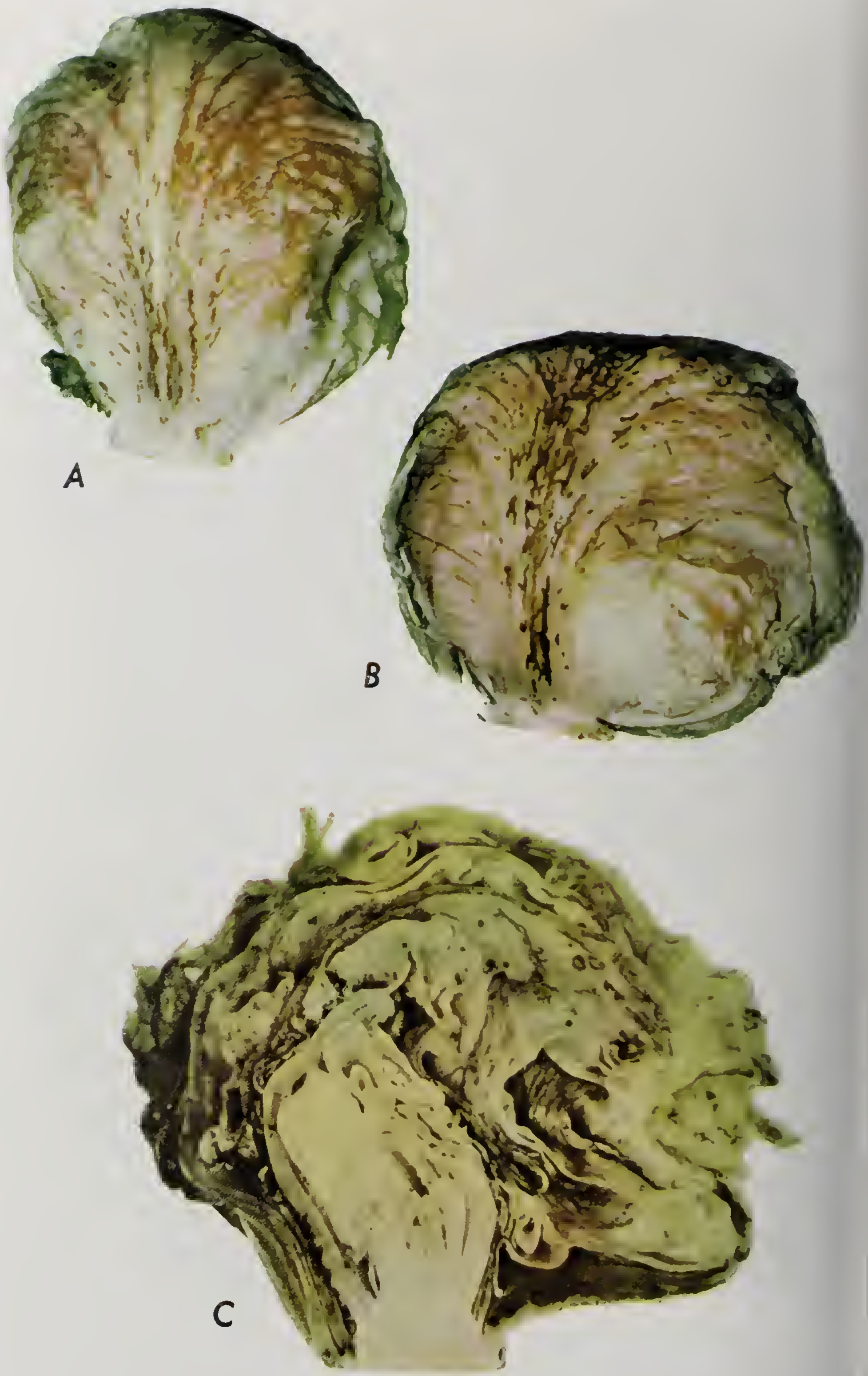


PLATE 6.—Lettuce disease: Spotted wilt. (Note curvature of petioles in C

Plate 7.—Rhubarb diseases: A, Stem spot; B, gray mold rot.

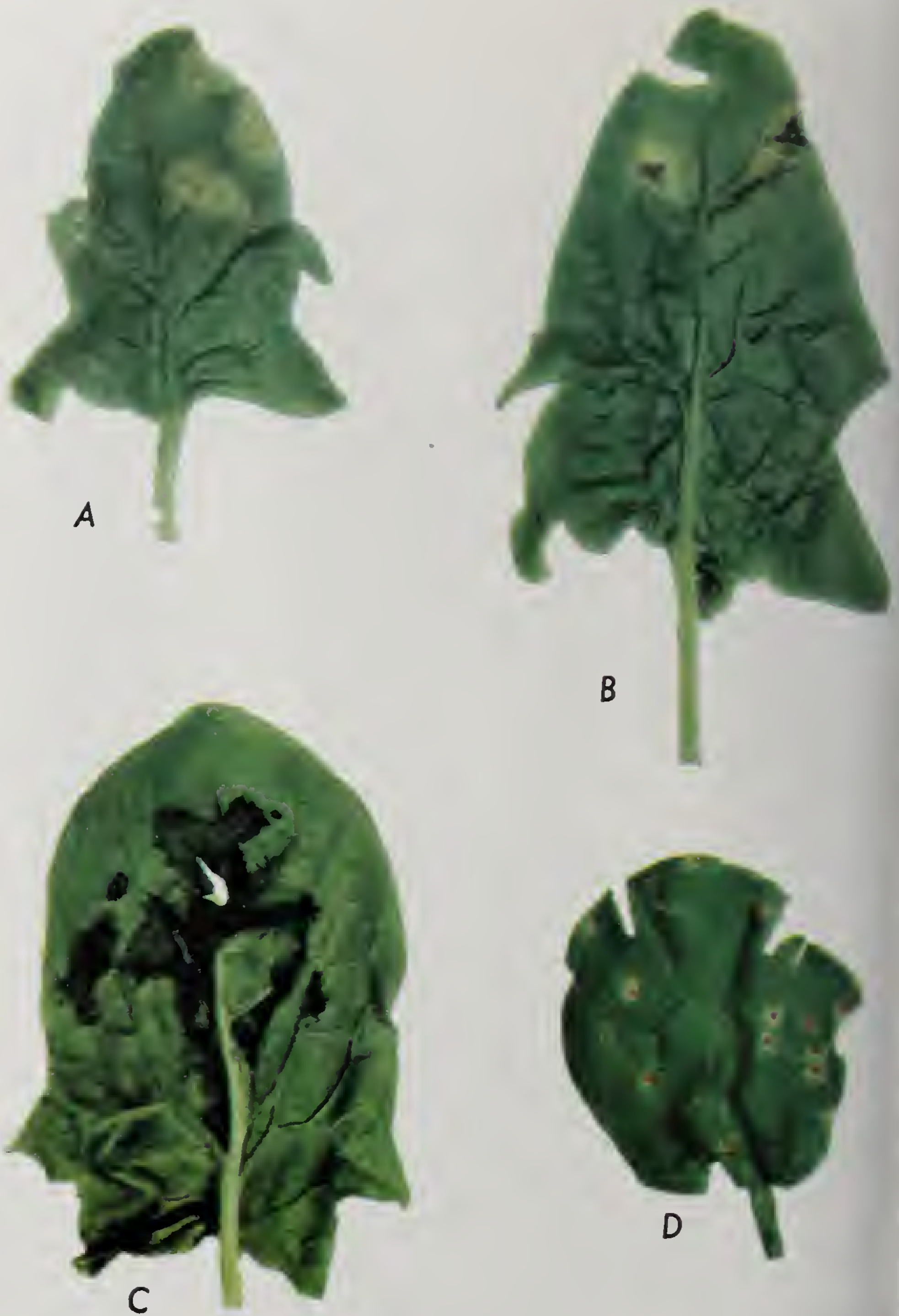


PLATE 8.—Spinach diseases: A and B, Downy mildew: C, bacterial soft rot: D, orange rust.

Plate 9.—Spinach diseases: A and B, White rust; C, heterosporium leaf spot.

Plate 10.—Sweetpotato disease: Black rot.

PLATE 11.—Sweetpotato disease: Charcoal rot.

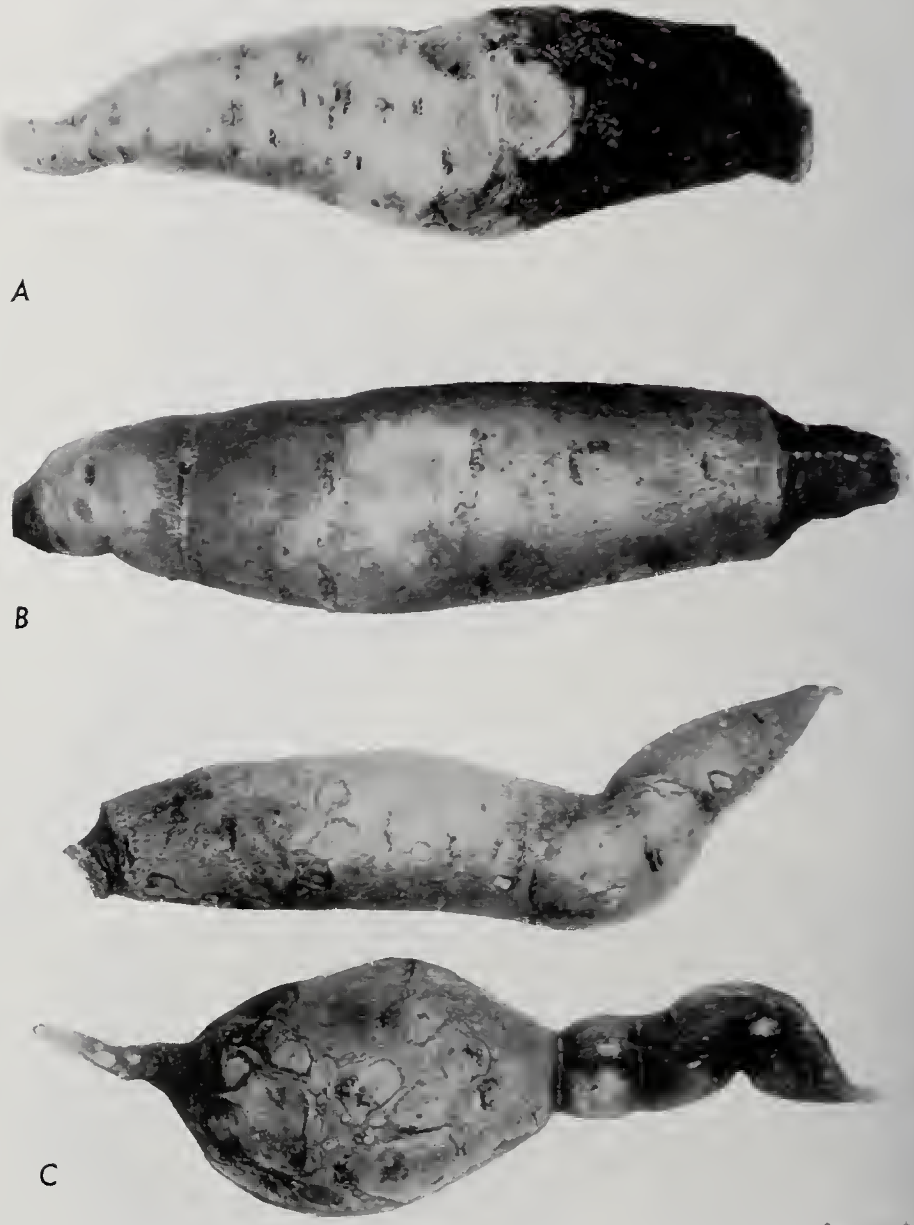


PLATE 12.—Sweetpotato diseases: A, Dry rot; B, end rot; C, surface rot.

PLATE 13.—Sweetpotato diseases: A, Foot rot; B, soil rot.

PLATE 14.—Sweetpotato diseases and injuries: A, Freezing injury; B, scurf; C, internal breakdown.

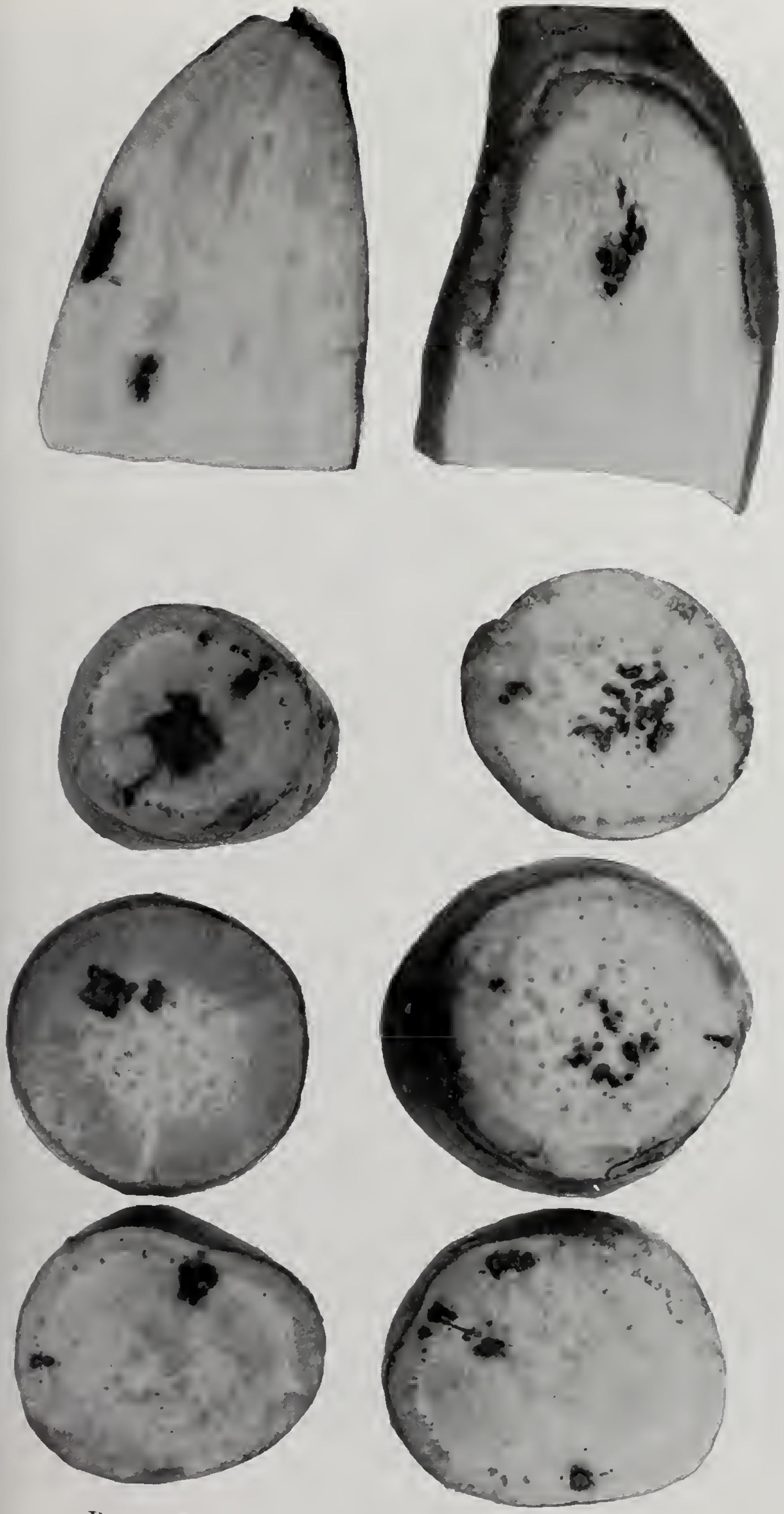
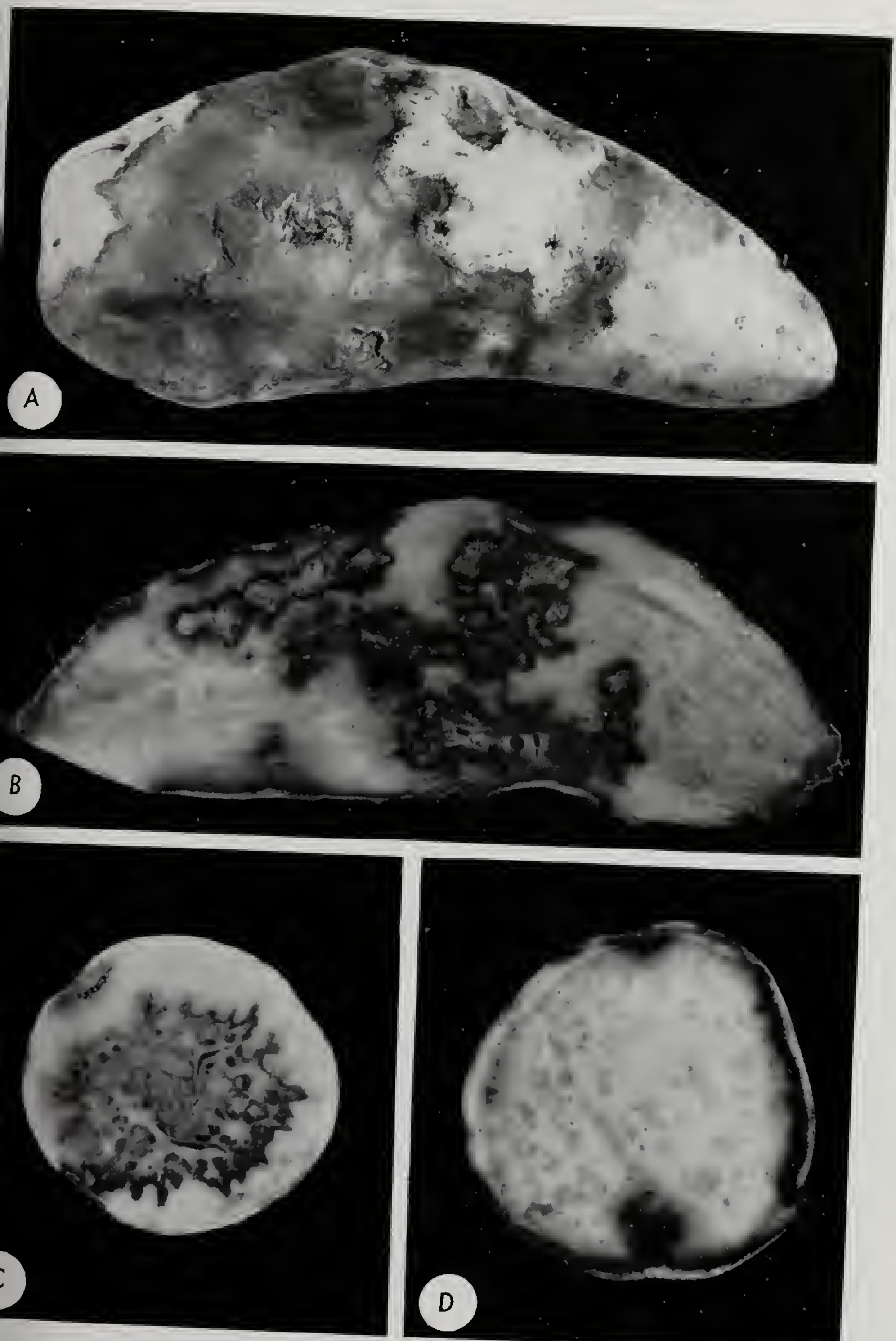


Plate 15.—Sweetpotato disease: Internal cork.

PLATE 16.—Sweetpotato disease: Java black rot. A and B, Early stage; advanced mummy stage.



TE 17.—Sweetpotato disease: Mottle necrosis. A, Surface view; B and C, ections showing mottle stage; D, section showing band type of discoloration nd decay.

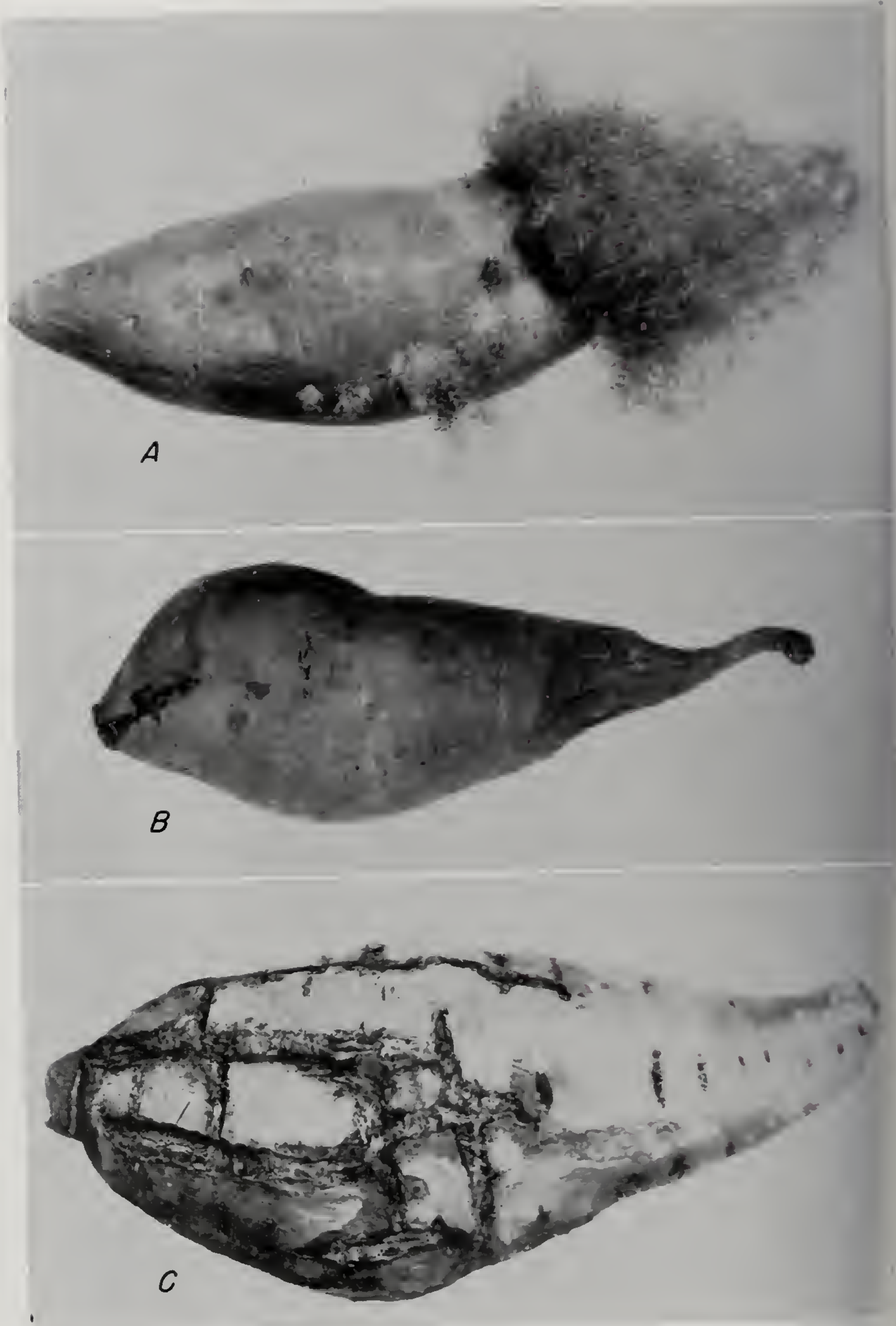


PLATE 18.—Sweetpotato disease and injury: A and B, Rhizopus soft rot; C, growth cracks.

PLATE 19.—Sweetpotato disease: Root knot.

the SAF stilling basin

A STRUCTURE TO DISSIPATE THE DESTRUCTIVE ENERGY IN HIGH-VELOCITY FLOW FROM SPILLWAYS

Agriculture Handbook No. 156

ural Research Service
eration with the
a Agricultural Experiment Station
Saint Anthony Falls Hydraulic Laboratory
NITED STATES DEPARTMENT OF AGRICULTURE

PREFACE

This publication is a condensed report of the research that led to the development of the St. Anthony Falls (SAF) stilling basin. It is prepared especially for the use of those who have occasion to design this efficient and economical outlet structure for dissipating the destructive energy in the high-velocity flow at the exit end of chutes, dams, closed conduit spillways, and similar structures.

The experimental work begun in January 1941 was completed in December 1943. The results of the tests were first reported in a processed publication in December 1943 that was revised in May 1949 (SCS–TP–79). A detailed report on the research has been published in the Transactions of the American Society of Civil Engineers, volume 113, 1948, "Development and Hydraulic Design, Saint Anthony Falls Stilling Basin."

This cooperative study in the solution of problems concerning the hydraulics of soil and water conservation structures was made by the staff of the Soil and Water Conservation Research Division, Agricultural Research Service, U. S. Department of Agriculture, in cooperation with the Saint Anthony Falls Hydraulic Laboratory and the University of Minnesota Agricultural Experiment Station.

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he SAF stilling basin

a structure to dissipate the destructive energy in high-velocity flow from spillways

Fred W. Blaisdell, *hydraulic engineer, Soil and Water Conservation Research Division, Agricultural Research Service*

THE PROBLEM

The research summarized in this publication is lirect result of the need for a stilling basin to sipate the energy in the high-velocity discharge m culverts, chutes, and other types of spillway. Engineering literature abounds with descrip-ns of stilling basins located at dams throughout world. Each structure, however, had been ividually designed for a specific location. Ad-onal studies were required to adapt a design other locations.

When the SAF stilling basin study was initiated 1941, at the request of the United States Soil servation Service, little had been accomplished ard the development of a universal design. general, the structures built by the Soil Con-ation Service are of such size that few of n can economically justify the individual lel studies that proved so profitable in the elopment of stilling basins for large dams. was essential, therefore, that an efficient and omical stilling basin be developed and that gn rules be formulated so future stilling ns could be designed without recourse to ier model studies.

PREVIOUS WORK

study of the literature on stilling basins ed out in 1941 revealed only two investiga- leading to the development of generalized ig basin designs. To the writer's knowledge, nly additional generalized studies that have published to July 1958 are those by Bradley Peterka (*5–11*).[1] In the simple stilling basin ed by Stanley (*18*), the energy in the high-ity flow is absorbed in a pool formed by a r low dam. The Schoklitsch energy dis-or (*17*) is similar to the simple stilling basin at an end sill is used to form a pool but the jet enters the pool above its bottom. This type is, therefore, somewhat more efficient than the simple stilling basin. Although both the Stanley and the Schoklitsch stilling basins are undoubtedly satisfactory in dissipating energy, a smaller and more economical stilling basin was needed.

THE TEST PROGRAM

Exploratory tests were made on the hydraulic jump, the Schoklitsch, and other published designs of stilling basins. Analytical studies were also made of several other stilling basin designs. As a result of these preliminary studies, some stilling basins were eliminated from further consideration because of their inferior performance in dissipating energy while others were eliminated because their size and cost for equivalent performance were greater than for the more efficient stilling basin.

On the basis of the exploratory tests, the rectangular stilling basin, developed by the United States Bureau of Reclamation and described by Warnock (*19*), was selected for further study. This stilling basin had chute and floor blocks to dissipate the energy and an end sill to deflect the stream away from the bed. The length of the stilling basin was 75 percent and the depth 85 percent of the hydraulic jump length and depth, respectively, but the indications were that the size could be reduced still further. Using this basic form of stilling basin, studies were directed toward determining the minimum dimensions for efficient energy dissipation and the laws governing the design of the various elements making up the basin.

The test program was divided into three parts: (1) The culvert-outlet series in which the basin proportions were determined for a narrow range of the Froude number; (2) the flume-outlet series of check tests, which covered a large range of the Froude number; and (3) the turbine-room series of large-scale check tests. The results of these tests are discussed in this publication.

[1] lic numbers in parentheses refer to Literature p. 14.

LABORATORY FACILITIES AND TEST METHODS

All experiments on the SAF stilling basin were made at the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota, Minneapolis. The laboratory is located on Hennepin Island at St. Anthony Falls in the Mississippi River. Up to 300 c. f. s. can be diverted from the river above the falls and returned to the river below the falls after dropping about 50 feet through the laboratory. Water for the various experiments is obtained through pipes connected to a supply canal running the full length of the laboratory.

The culvert and flume series of tests were conducted in a channel 24 inches deep, 18 inches wide, and 8 feet long; the turbine-room series in a channel 6 feet wide and 24 feet long. Since it was impossible to observe from above the operation of the stilling basin under the jet and "white water," all tests were conducted on half-models; that is, the models were split along their centerline and one-half of the model was pressed against a glass plate through which the action of the stilling basin could be observed. Check tests showed that identical results can be obtained from either full or half models. A glass observation panel 8 feet long was located on one side of the 18-inch channel and a panel 2 feet high and 12 feet long on the side of the 6-foot channel; the model centerlines were located along the face of the panels.

Water for the culvert and flume series was obtained through a 4-inch pipe and the discharge controlled by a 3-inch gate valve. The rate of flow was measured by a calibrated 1-foot type HS flume. Water for the turbine-room series was obtained through an 18-inch pipeline that was reduced to 12 inches before reaching the model. The rate of flow was controlled by a 12-inch gate valve and measured by the calibrated pressure difference across the 18-inch by 12-inch reduction, by a calibrated 1.5-foot type H flume, or by a Pitot tube located at the stilling basin entrance.

For the culvert series of tests, the approach to the models was a 3-inch square pipe. The depth of flow at the entrance to the stilling basin was determined by the discharge and the width of the open channel transition used between the pipe and the stilling basin. The depth at the stilling basin entrance for the flume and turbine-room series was set by means of adjustable gates located just upstream from the models. For these series it was possible to regulate both the depth and velocity at the stilling basin entrance. The approach channel width was 3 inches for the flume series and 1 foot for the turbine-room series.

All models were made of wood—waterproof plywood for the smaller models and pine for the larger models.

The tailwater depth was controlled by stop logs located in both channels at the downstream end of the test section. Depths and sand-contour elevations were measured with point gages located on traveling carriages. Centerline profiles of the water surface and eroded sand bed were sketched on data sheets with the aid of a grid of uniformly spaced strings placed against the glass observation panels.

The stream bed downstream from the stilling basin was formed in concrete sand. The effec tiveness of each arrangement of stilling basin in removing the destructive energy in the water wa measured by the erosion of this sand bed. Th loose sand was scoured to its approximate ulti mate depth in 30 minutes, and this length of ru was used for the culvert and flume series o tests. Two-hour runs were found to be mor satisfactory for the large-scale turbine-room serie

Before beginning each experiment, the strea bed was filled in with sand and a small stream c water was used to fill the channel without erodin the stream bed. At the beginning of the ru the valve was opened quickly to give the desire discharge and at the end of the run the valve wa closed quickly. Data on the discharge, tailwat level, and water-surface profile were obtain during the run. Photographs were made durin many runs. After the run the sand bed w drained and the erosion was recorded.

The procedure used in determining the be proportions of the various elements making up t stilling basin was to run a group of tests and ma changes on only one element between each te so that any differences observed in the perfor ance of the stilling basin could be attributed the change in the pertinent element. This sing element was varied in shape, size, or positi until the best proportions and location had be ascertained. Other elements were then studied like manner until the best proportions of all pa of the stilling basin had been tentatively det mined. Because of the interdependency of t various elements, it was necessary to rep certain steps to ascertain the effect of subseque changes on elements studied previously.

After ascertaining the most satisfactory still basin proportions for a single rate of flow, dimensions were varied for other rates of flow determine the laws governing the proportions the stilling basin and its elements. All these te were part of the culvert-outlet series. Both flume-outlet and turbine-room series were ch tests. The only important revisions in the des resulting from the tests with other rates of f were in the end sill height and the wingw shape and position. All changes indicated a result of the check tests were made and verif

HYDRAULIC JUMP

All the dimensions of the SAF stilling ba are related, either directly or indirectly, to hydraulic jump. The theoretical equation for hydraulic jump is

$$d_2=-\frac{d_1}{2}+\sqrt{\frac{2V_1^2d_1}{g}+\frac{d_1^2}{4}}$$

ıere d_2 is the depth after the jump, d_1 the depth eceding the jump, V_1 the velocity preceding the np, and g the acceleration due to gravity (32.2 t per second per second). The derivation of s equation can be found in most books on draulics; for example, the "Handbook of draulics" (*15, pp. 8-23 to 28*). Numerous periments by others have proved the validity this equation, which can be simplified to

$$d_2=\frac{d_1}{2}\left(-1+\sqrt{8F+1}\right) \qquad (2)^2$$

ere the Froude number F is given by the equa-
ı

$$F=\frac{V_1^2}{gd_1} \qquad (1)$$

his dimensionless number (F), a constant similar flow conditions in the model and the otype, is also used in the determination of size of the stilling basin.

he length of the hydraulic jump is assumed to d_2, after Bakhmeteff and Matzke (*1*).[3]

TEST RESULTS

ıe SAF stilling basin design was developed verified as a result of 271 tests. The number sts in each series and the range of the vari- are given in table 1, where Q is the discharge, V_1d_1/ν is the Reynolds number, and ν is kinematic viscosity. The tests made on element comprising the SAF stilling basin e discussed separately.

umbers in parentheses opposite the equations refer equations listed on the design chart, pp. 8 and 9.

adley and Peterka (*5, 6*) show that the hydraulic length varies with the Froude number, reaching a ıum length of about $6.1d_2$. However, this difference, length has no effect on the SAF stilling basin e the hydraulic jump length does not enter directly ıe SAF design, and the tests on the SAF stilling covered the practical range of Froude numbers.

Length of Basin

The full length of the rectangular stilling basin described by Warnock (*19*) was not utilized in dissipating the energy in the water. (The length of this basin, L_B, was 75 percent of the hydraulic jump length, or, $L_B=0.75 \times 5d_2=3.75d_2$.) The stilling basin was shortened in steps until a minimum length equal to $0.70d_2$ was reached. Surprisingly, the depth of the scour hole was not increased by this shortening until a length of stilling basin less than $1.25d_2$ was tested. The channel erosion was markedly but not dangerously increased when $L_B=1.00d_2$. When the basin length was $0.70d_2$, the scour at the end of the stilling basin as well as in the downstream channel was considered excessive and the energy dissipation in the stilling basin was poor. A stilling basin length of $1.25d_2$ was used in subsequent tests in which the positions and sizes of the other elements making up the basin were investigated. The Froude number was about 30 for tests up to this point.

Further study of the stilling basin length was initiated after tentatively determining the best sizes and locations of the chute and floor blocks and the end sill. These tests covered a range of the Froude number from 3 to 150 and were part of both the culvert and flume-outlet series. As a result of these tests, it was discovered that the stilling basin was too short for Froude numbers less than 30 and longer than necessary for larger Froude numbers. The stilling basin length, therefore, was varied for each of 12 values of F until the best length was determined. The performance of each length of basin was "rated" and plotted, with L_B/d_2 and F as coordinates, and a curve drawn through the plotted points. Both the experience obtained during the experiments and the plotted data were used in locating this curve. The equation of this curve,

$$\frac{L_B}{d_2}=\frac{4.5}{F^{0.38}} \qquad (4)$$

is suggested as giving a minimum safe length of stilling basin; it is conservative, but not to the point where the material in the outlet is wasted.

TABLE 1.—*Tests of SAF stilling basin and range of test variables*

Series	Tests	Q	V_1	d_1	d_2	F	$R \times 10^{-3}$
	Number	*C. f. s.*	*F. p. s.*	*Ft.*	*Ft.*		
outlet	100	0. 09 to 0. 4	4. 3 to 12	0. 04 to 0. 17	0. 17 to 0. 8	3 to 57	12. 7 to 45
outlet	108	. 04 to . 8	2. 8 to 22	. 05 to . 15	. 13 to 1. 8	5 to 200	14. 2 to 237
room	66	. 40 to 21.	9. 7 to 44	. 03 to 1. 27	. 49 to 5. 5	7 to 288	40. 6 to 2, 100
Total tests and total range in variables.	274	. 04 to 21.	2. 8 to 44	. 03 to 1. 27	. 13 to 5. 5	3 to 288	12. 7 to 2, 100

Equation 4 was developed for a range of the Froude number from 3 to 150, but it was later used to design experimental stilling basins having values of $\boldsymbol{F}$ as high as 300. The results of all subsequent tests show that stilling basin lengths determined from equation 4 are satisfactory.

Chute Blocks

The chute blocks, located at the entrance to the stilling basin, serve to increase the effective depth of the entering stream, break the stream up into a number of small jets, and help create the turbulence required for effective energy dissipation.

The original height of the chute blocks was d_1, and the width and spacing, $0.75d_1$. A test on a solid chute block, such as is used in the Schoklitsch energy dissipator, showed that less energy was dissipated in the stilling basin and that flow conditions in the channel downstream from the stilling basin were not so good. A second test was made in which the tops of the chute blocks were sloped to direct the jets at the floor blocks. The result of this change was to increase the depth of erosion near the end of the stilling basin.

The chute blocks used for all subsequent tests had a height of d_1 and a width and spacing of $0.75d_1$. These proportions proved to be entirely satisfactory. It makes no difference in the performance of the stilling basin whether a chute block or a space is next to the sidewall as long as the blocks are symmetrical about the centerline of the outlet.

Floor Blocks

Energy is removed from the water by impact against the floor blocks and considerable turbulence is created by them.

The first tests on the floor blocks were made to determine their best longitudinal position. These tests show that it is equally as bad to have the distance between the chute and floor blocks too short as it is to have the distance between the floor blocks and end sill too short. If the distance between the chute and floor blocks is too short, the blocks act like a solid chute block. If the distance between the floor blocks and end sill is too short, the blocks and sill act as a unit in deflecting the jet upward.

Nearly identical results were obtained when the floor blocks were located $L_B/3$ and $L_B/2$ from the upstream end of the stilling basin. The results for the $L_B/3$ spacing were slightly better, but the difference probably is insignificant. The floor blocks were located $L_B/3$ from the upstream end of the basin for all subsequent tests. No reason was discovered for changing their longitudinal location as a result of these tests.

Floor blocks were tried with heights both greater and less than d_1. This height of floor block was either as good as or better than greater and lesser heights. Accordingly, a floor block height equal to d_1 was used for subsequent tests.

The width and spacing of the floor blocks should be the same as for the chute blocks. However, for those stilling basins in which the sidewalls diverge in plan, the width and spacing of the floor blocks should be increased over the chute block width and spacing to compensate for the greater stilling basin width at the floor block location.

No floor block should be located closer to the stilling basin sidewall than $3d_1/8$. Floor blocks located closer cause a high boil that might overtop the sidewall.

Insufficient water can pass between the floor blocks if they occupy too much of the stilling basin width; they then act more like a sill than like individual blocks. The test results show that satisfactory conditions exist when the floor blocks occupy between 40 and 55 percent of the stilling basin width. The aggregate width of all floor blocks, therefore, should be held within these limits, even if it is necessary to reduce the width of the floor blocks to do so.

The floor blocks always should be placed downstream from the openings in the chute blocks to break up the jets issuing from between the chute blocks and passing along the stilling basin floor. A single test made with the floor blocks in line with the chute blocks was sufficient to show the inferiority of this arrangement.

The floor blocks may be piers square in plan with vertical faces, or their downstream faces may slope as shown on the design chart.

Force on Floor Blocks

A knowledge of the forces exerted on the floor blocks is necessary for their structural design. No tests were made to determine these forces. It is possible, however, to compute the maximum probable forces, and the results of experiments by others are available to modify these computed values.

The impact force on the floor blocks required to turn the flow 90° is given by the equation $F=AV_1^2w/g$, where F is the total force, A is the area of the face of the blocks, and w is the unit weight of water (62.5 pounds per cubic foot). It is convenient to write the impact force in terms of d_1 and $\boldsymbol{F}$, since both of these values are required in the design of the stilling basin. The force per unit width of the floor block, f, is

$$f=wd_1^2\boldsymbol{F}$$

This equation gives the maximum impact force on the floor blocks per unit width of block. The equation assumes that all the water approaching the block is turned at right angles to its original direction. Much of the water changes direction only slightly, so the actual force must be considerably less than the computed maximum. Other factors that influence the force on the floor blocks are the shape, width, and spacing of the blocks, the effect of the chute blocks, and the fact that the mean velocity at the floor blocks is

ced by the chute blocks and the roller. Such ormation as is available regarding the effect these factors will be presented.

The forces on stepped blocks and streamlined cks measured experimentally at the Massa- isetts Institute of Technology have been re- ted by Harleman (*14*). The stepped blocks proximate the shape of the vertical-faced blocks d in the SAF stilling basin. Harleman states: ne maximum force exerted by the baffle piers f the order of 20 percent of the pressure force to the downstream depth." Since the down- am force is applied across the full width of stilling basin and the stepped blocks occupied percent of the basin width, the maximum sured force per unit width of blocks is 40 ent of the pressure force per unit width due to downstream depth. Using this latter figure, found that the maximum force per unit width lock varies from 27 percent of the theoretical e for $F=3$ to 38 percent of the theoretical for $F=300$.

npublished results of tests made at the St. hony Falls Hydraulic Laboratory in connec- with a model study of the Chippewa River rvoir Dam of the Northern States Power substantiate the MIT values. Piezometric ures were measured on the face of a baffle located below a Tainter gate, and the pres- were integrated to determine the total force e baffle. Forces determined for three dif- t rates of flow amounted to 43 percent, 24 nt, and 27 percent of the impact forces uted as outlined above.

view of these data and until better informa- is available, it is suggested that the force e floor blocks exerted by the approaching n be taken as 40 percent of the computed t force, or

$$f=0.4\ wd_1^2\boldsymbol{F}=25\ d_1^2\boldsymbol{F}$$

ill

end sill, located at the downstream end of illing basin, deflects the bottom currents d and away from the stream bed. In on, a ground roller is created under the ed stream, which brings bed material from tream and deposits it at the end of the basin.

height of the end sill, c, for the culvert- series was made $d_2/7$. This end-sill height to be satisfactory for the narrow range of oude number for which it was derived, but uation was inadequate for a larger range Froude number.

horough study of the end-sill height for of F from 5 to 200 was made as part of the utlet series of tests. The best height of for each set of otherwise constant condi- as selected, and the selected values were o be independent of the Froude number. er, when c/d_2 was plotted against the Reynolds number R, a well-defined curve was obtained, although there is no reason to believe that such a relationship should exist. A study of the equation for this curve showed that the height of the end sill was unbelievably low for values of R within the practical range. This naturally cast suspicion on the form of the end-sill height equation and led to the turbine-room tests, which were made at higher Reynolds numbers.

The turbine-room tests confirmed the opinion that the end-sill height was too low for the higher values of R and indicated that c/d_2 was independent of both F and R. A tentative equation ($c=0.07d_2$) was derived early in the test program. This equation was checked by other tests until it became apparent that this end-sill height would be satisfactory. Subsequent tests were made to verify this equation.

A review of the data obtained during the flume-outlet series of tests shows that satisfactory erosion conditions were obtained when $c=0.07d_2$. The higher end sills given by the equation containing R produced slightly better erosion patterns for the lower values of R, but the difference is so small as not to warrant the use of separate equations. The recommended equation for the height of the end sill is

$$c=0.07d_2 \tag{6}$$

Tailwater Depth

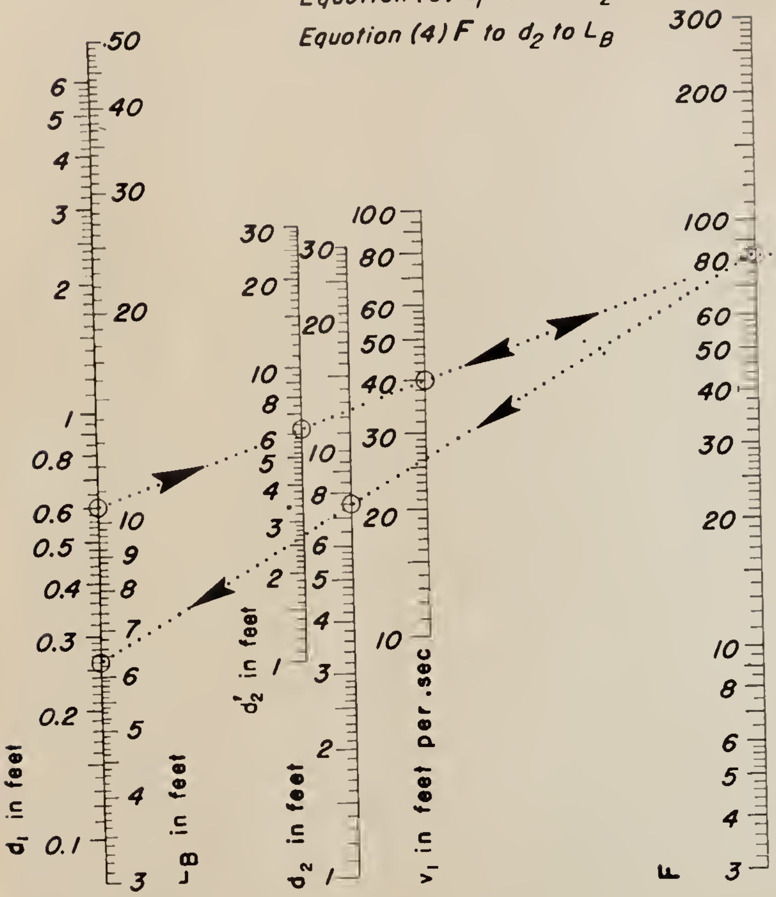
Use of the blocks and end sill in the stilling basin permits the depth of the tailwater above the stilling basin floor level to be decreased over that for the theoretical tailwater depth of the hydraulic jump. Warnock (*19*) recommended a 15-percent reduction, so that the actual tailwater depth, d'_2, would be $0.85d_2$. Tests were made to check this figure.

If the tailwater depth is too low, the roller on the hydraulic jump will be washed out of the stilling basin and the floor blocks and end sill will simply deflect the stream and break it up. The broken-up stream will land on the water surface some distance downstream from the outlet and erode the bed only slightly, with the depth of the scour hole near the end of the stilling basin remaining unchanged. The structure will not be endangered thereby, but the energy dissipation in the stilling basin is poor and the spray may prove objectionable.

In determining the minimum permissible value of d'_2, the tailwater depth was decreased until the roller was washed out of the stilling basin. The relative tailwater depth at which this occurred was plotted against F. Originally the relative tailwater depth was assumed to be d'_2/d_2. When a paper (*2*) describing development and hydraulic design of the SAF stilling basin was published, however, one of the discussers showed that plotting the ratio d'_2/d_1 permitted the derivation of a relationship that is continuous over the range of Froude numbers covered by the tests. As a result of this discovery, d'_2/d_1 was plotted against

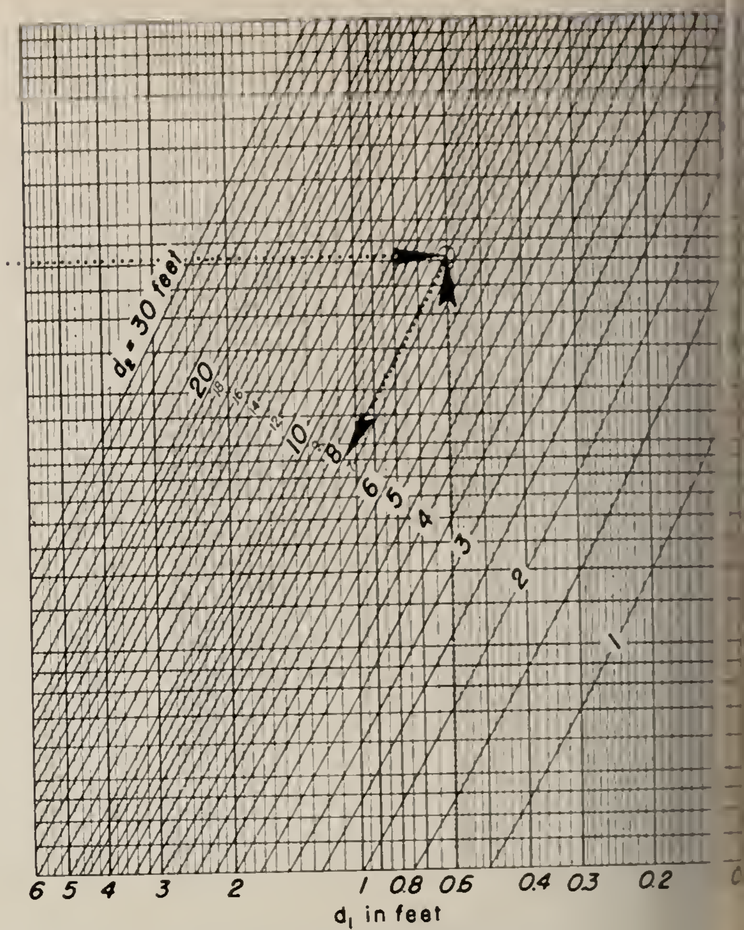
A. SOLUTION OF EQUATIONS (1), (3) AND (4)

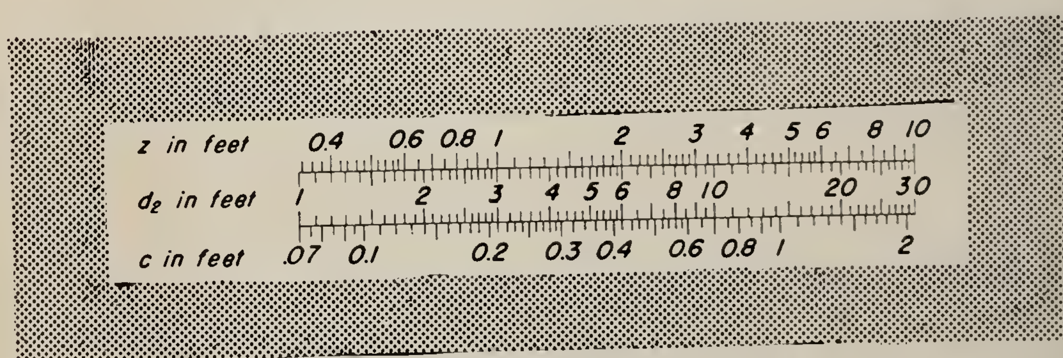
Procedure. Equation (1) d_1 to v_1 to F
Equation (3) d_1 to F to d_2'
Equation (4) F to d_2 to L_B



B. SOLUTION OF EQUATION (2)

Procedure: F to d_1 to d_2





C. SOLUTION OF EQUATIONS (5) AND (6)

Procedure: Equation (5) d_2 to z
Equation (6) d_2 to c

D. EXAMPLE

GIVEN: $d_1 = 0.6$ ft. and $v_1 = 40$ ft. per sec.

SOLUTIONS OF EQUATIONS
(using curves and nomographs)

(1) $F = 83$ (2) $d_2 = 7.4$ ft. (3) $d_2' = 6.1$ ft.

(4) $L_B = 6.3$ ft. (5) $z = 2.48$ ft. (6) 0.52 ft.

E. DESIGN EQUATIONS

(1) $F = \frac{v_1^2}{g d_1}$

(2) $d_2 = \frac{d_1}{2}(-1 + \sqrt{8F}$)

(3) $d_2' = 1.4 d_1 F^{0.45}$

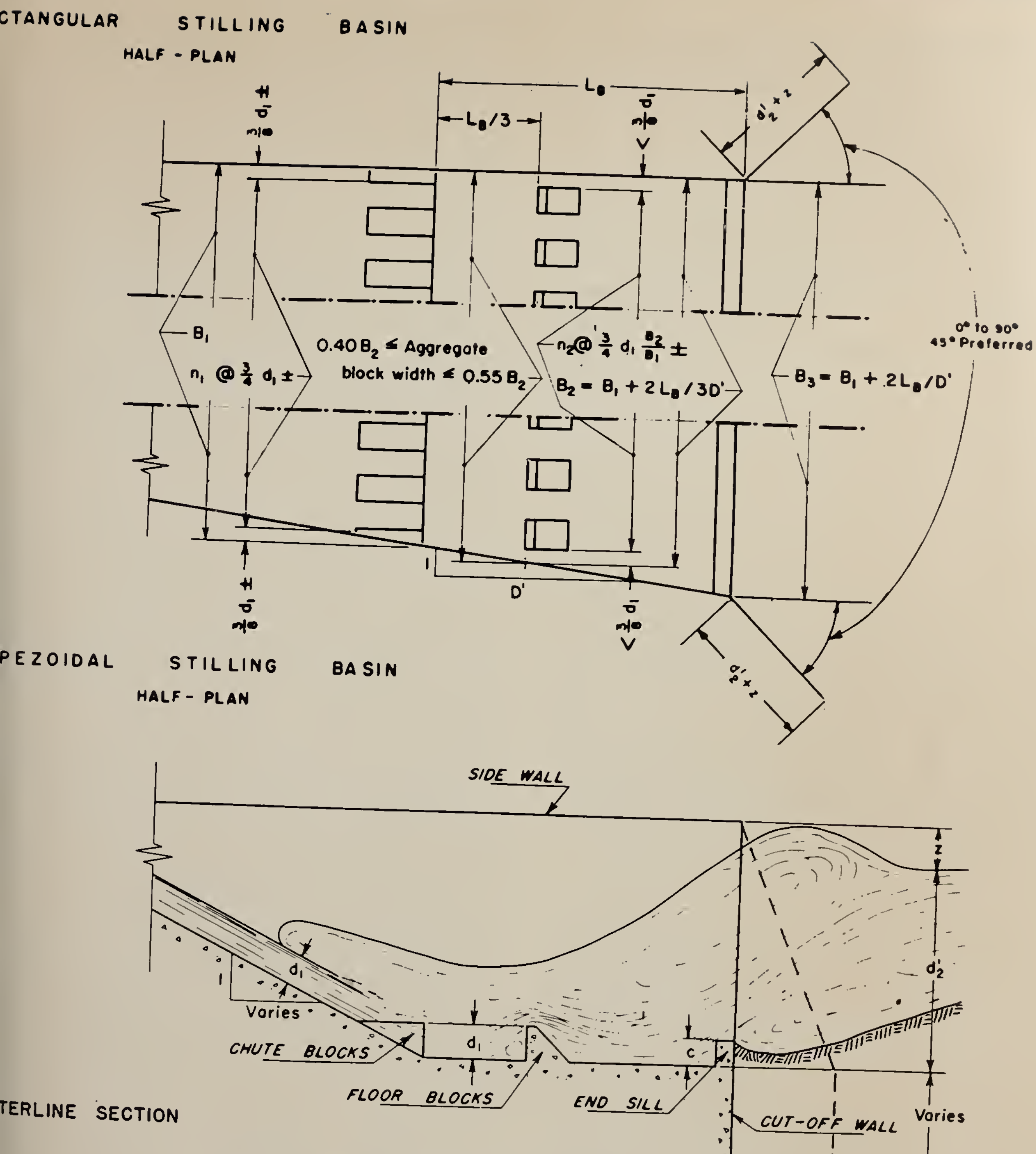
(4) $L_B = \frac{4.5 d_2}{F^{0.38}}$

(5) $z = d_2/3$

(6) $c = 0.07\, d_2$

FIGURE 1 - DESIGN CHART for SAF STILLING BA[IN]

Agricultural Research Service, U. S. Department of Agriculture, in cooperation with the Minnesota Agricultural Experiment Station and the St. Anthony Falls Hydraulic Laboratory, University of Minnesota.



F. PROPORTIONS OF THE SAF STILLING BASIN

G. DEFINITIONS OF SYMBOLS

dth of stilling basin at upstream end, in feet
dth of stilling basin at floor blocks, in feet
dth of stilling basin at downstream end, in feet
ght of end sill, in feet
th of flow at entrance to stilling basin, in feet
wnstream depth computed by momentum equation
for the hydraulic jump, in feet
er surface elevation in downstream channel
above stilling basin floor, in feet

D' - side wall divergence, D' longitudinal to 1 transverse

F - the Froude number

g - acceleration due to gravity, in feet per second per second

L_B - length of stilling basin, in feet

V_1 - velocity at entrance to stilling basin, in feet per second

z - height of stilling basin side walls above maximum tailwater level, in feet

F and an enveloping curve drawn above the relative depths at which the roller is washed out of the stilling basin. The equation of this curve is

$$\frac{d'_2}{d_1}=1.4F^{0.45} \qquad (3)$$

Sidewall Height

The flow in the stilling basin is very turbulent, and, as a result, the water surface is so rough that some freeboard above tailwater level is necessary if overtopping of the sidewalls is to be prevented. In addition to the surface roughness, a standing wave, or boil, is caused by the floor blocks and end sill, which in itself requires freeboard above the tailwater level. For Froude numbers less than about 20, the crest of the boil is in the stilling basin, whereas, for higher Froude numbers, the boil crest occurs downstream from the end of the basin and its full height need not be considered in designing the sidewall height.

Average profiles of the water surface in the stilling basin were obtained for all series, but the maximum height of splash was obtained for only the turbine-room series. It is from these latter tests that the height of the sidewall is determined.

The maximum height of the splash z_{max} in the stilling basin was divided by d_2. There is considerable scatter to the data, but z_{max}/d_2 is apparently independent of $\boldsymbol{F}$. The range of z_{max}/d_2 is from -0.02 to 0.31. A study of the data shows that if the height of the stilling basin sidewall, z, above the maximum tailwater level is given by the equation

$$z=d_2/3, \qquad (5)$$

the freeboard will be sufficient to keep the splash in the stilling basin. Because of the scatter in the data, the freeboard provided by this equation will, in some cases, be greater than is necessary to protect fully the structure, but the safety factor is not excessive for the average case.

Wingwalls

Wingwalls at the end of the stilling basin are used as retaining walls to hold back the earth fill. The ordinarily used wingwall is rectangular in downstream elevation. Since the scour around the end of this wall is severe, other wingwall shapes were investigated.

The principal cause of the scour around the end of the wingwall is an eddy along each side of the downstream channel that is driven by the stream leaving the stilling basin. It is imperative that the concentration of the flow from this eddy be kept off the stream bed. Two methods can be used to prevent the eddy from attacking the stream bed: (1) A submerged extension of the wingwall, having a height equal to half the tailwater depth and a length equal to 0.6 of the sidewall height (the minimum length of rectangular wingwall used in the experiments was 0.4 of the sidewall height); or (2) a wingwall of triangular shape in downstream elevation, the top having a slope of 1:1. The triangular shape of wall is recommended, because it is equally as satisfactory in preventing scour as is the extended wingwall and, in addition, requires less material.

Wingwalls have been customarily located perpendicular to the centerline of the outlet structure. Tests have shown, however, that the wingwalls may be extended parallel to the basin centerline if field conditions make it necessary to do so, although the boil height is considerably higher. Nevertheless, the best overall conditions are obtained if the triangular wingwalls are located at an angle of about 45° to the outlet centerline.

Subsequent tests of other types of stilling basins have confirmed the superior performance of the wingwall having a 1:1 top slope located at an angle of 45° to the outlet centerline (*4*, *12*, *13*).

Shape of Basin

The size of the stilling basin varies with the initial flow depth if V_1 does not change; any reduction in d_1 will reduce d_2, the length of the basin the height of the sidewalls, and the depth o excavation. In addition, a larger percentage o the energy in the water entering the stilling basin will be dissipated. A saving in overall cost of th outlet will ordinarily be possible if a flaring sidewall transition is placed between the culver or chute and the stilling basin to accomplish thi reduction in d_1 (*3*). In those cases where transition is used, the diverging transition side walls should be extended to form the stilling basi walls. The resulting stilling basin is trapezoid in plan, as is shown on the design chart, page

A few tests were made on a trapezoidal-shape stilling basin in the culvert-outlet series. Th stilling basin was designed for flow conditions its entrance. The width and spacing of the flo blocks were multiplied by the ratio B_2/B_1 to com pensate for the increase in the width of the stillin basin at their location. All blocks had their ax parallel to the centerline of the basin. Flo conditions in the downstream channel were som what improved through the use of the trapezoid stilling basin. This is because the velocity of t flow was lower at the exit from the basin, and t widening of the stream to fill the downstrea channel reduced the size of the eddies along t channel sides near the stilling basin.

Cutoff Wall

A cutoff wall is used at the end of the stilli basin to prevent scour from undermining t basin. Obviously, the depth of the cutoff w must be greater than the maximum depth of er sion at the end of the stilling basin.

Serious erosion near the end of the stilling ba is prevented by the end sill, which deflects upw the stream leaving the basin. A ground rol under the deflected stream brings material u stream and further aids in preventing erosi

he laboratory, the scour sometimes reached an
ation slightly below the floor of the stilling
n, but the scour never reached a depth at the
of the basin greater than the thickness of a
slab that might be used. Therefore, a cut-
vall of only nominal depth need be used at the
of the stilling basin.

ct of Entrained Air

r is ordinarily entrained by the water flowing
utes laid on a steep slope. This results in a
ly increased depth of flow of the mixture.
ever, no air was naturally entrained by the
r during the model tests because of the low
ities or the short length of channel. Because
ined air may affect the performance of the
g basin, a few tests were made in which from
117 percent of air was mixed with the water.
stilling basins were designed as if the water
free of air, and duplicate tests were run both
and without air entrainment. Identical
s, within the limits of experimental preci-
were obtained from the duplicate tests.
ugh d_1 is greater when air entrainment
, d_2 remains unchanged, since the air sepa-
from the water, owing to the lower velocities
downstream channel. No increase in side-
eight is required as a result of air entrain-

results of these tests show that the effect of
trainment can be neglected in the design
SAF stilling basin. The resulting structure
fely handle any flows in which air is en-
l.

CONCLUSIONS

following conclusions are reached as a
of the tests made to develop and verify the
illing basin design:

The length of the stilling basin for Froude
numbers between 3 and 300 is

$$L_B=4.5d_2/\boldsymbol{F}^{0.38} \qquad (4)$$

The height of the chute blocks and the floor
locks is d_1; their width and spacing are
pproximately $3d_1/4$; either a chute block
r a space may be located next to the side-
all if the blocks and spaces are sym-
etrical about the outlet centerline.

he floor block criteria are as follows:

a. The distance from the upstream end of the stilling basin to the floor blocks is $L_B/3$.
b. No floor block should be placed closer to the sidewall than $3d_1/8$.
c. The floor blocks should be placed downstream from the openings between the chute blocks.
d. The floor blocks should occupy between 40 percent and 55 percent of the stilling basin width.
e. The widths and spacings of the floor blocks for diverging stilling basins should be increased in proportion to the increase in stilling basin width at the floor block location.
f. The floor blocks may be piers square in plan with vertical faces, or their downstream faces may slope as shown on the design chart.
g. The force per foot width exerted on the floor blocks by the approaching stream may be taken as

$$f=25d_1^2\boldsymbol{F}$$

4. The height of end sill is

$$c=0.07d_2 \qquad (6)$$

5. The depth of the tailwater above the stilling basin floor is

$$d'_2=1.4\boldsymbol{F}^{0.45}d_1 \qquad (3)$$

6. The height of the sidewall above the maximum tailwater depth to be expected during the life of the structure is

$$z=d_2/3 \qquad (5)$$

7. Wingwalls should be equal in height and length to the stilling basin sidewalls. The top of the wingwall should have a 1:1 slope. Wingwalls flaring at 45° with the outlet centerline are preferred to wingwalls that are perpendicular or parallel to the centerline.
8. The stilling basin sidewalls may be parallel (rectangular stilling basin) or diverge as an extension of the transition sidewalls (trapezoidal stilling basin).
9. A cutoff wall of nominal depth should be used at the end of the stilling basin.
10. The effect of entrained air should be neglected in the design of the stilling basin.

During the tests it was noticed that the performance of the SAF stilling basin was excellent at discharges less than the design discharge. At the design flow the SAF stilling basin provides an economical method of dissipating energy and preventing dangerous stream bed erosion.

APPLICATION OF RESULTS

Design Chart

The results of all the tests on the SAF stilling basin are summarized on the design chart for the SAF stilling basin (fig. 1).

The proportions of a SAF stilling basin can be determined from the chart without the aid of any instrument or any other design chart or table. The use of the design charts is explained thereon,

a typical problem is solved, and the principal dimensions determined.

The stilling basin dimensions obtained from the design charts will result in a good design. Slight variations in the dimensions, however, will have little or no effect on the performance of the basin. To simplify the construction, all odd dimensions should be changed to even dimensions.

Solution of a Typical Problem

A rectangular SAF stilling basin is to be constructed at the end of a 3-foot wide chute. The depth and velocity at the end of the chute are 0.6 foot and 40 f. p. s., respectively, the design tailwater elevation is 377.0, and the maximum tailwater elevation in the downstream channel anticipated during the life of the structure is 378.5 for the design discharge of 72 c. f. s.

Reading the principal dimensions from the design charts it is found that: $\boldsymbol{F}=82.8$, $d_2=7.43$ feet, $d'_2=6.13$ feet, $L_B=6.28$ feet, $z=2.48$ feet, and $c=0.520$ foot. In order to simplify the construction, $L_B=6$ feet 3 inches, and $c=6$ or 7 inches can be used without affecting the operation of the structure. The elevation of the top of the sidewalls, which is determined from the maximum tailwater elevation, is $378.5+2.48=380.98$; use 381.00. The force on the floor blocks is $25\text{x}0.6^2\text{x}82.8=745$ pounds per foot of width.

The elevation of the basin floor is $377.0-6.13=370.87$. The tailwater level and required tailwater depth also should be checked at discharges less than the design value to insure proper stilling action at all flows. Finally, consideration of the possibility that the channel bed elevation—and, as a result, the tailwater level—may become lower in time, suggests that the stilling basin floor be set below the calculated elevation. The amount will depend upon local conditions and the judgment of the designer. The wingwall will have a length of about 9 feet, depending on the sidewall height, and its top a slope of 1 : 1. A cutoff wall under the stilling basin having a depth of 2 feet or more should be used.

Several arrangements of the 6- or 7-inch high chute and floor blocks are possible, the floor blocks being placed $\frac{\text{6 feet 3 inches}}{3}=2$ feet 1 inch, say 2 feet, downstream from the upper end of the basin.

The chute and floor blocks and the spaces between them can be made $0.6\text{x}\frac{3}{4}=0.45$ foot$=5\frac{1}{2}$ inches, say 6 inches. This gives $36/6=6$ spaces across the stilling basin. Now, locate chute blocks 3 inches from either side of the chute and one straddling the centerline. Two floor blocks can now be located in the basin downstream from spaces between the chute blocks. No floor blocks should be located next to the basin walls. The proportion of the basin width occupied by the floor blocks is $2\text{x}6/36=0.33$. This proportion for floor blocks is lower than is recommended. This difficulty can be overcome by making the bloc[k] width and spacing 8 inches. The proportion the[n] becomes $2\text{x}8/36=0.44$. The total force on eac[h] block is $745\text{x}8/12=500$ pounds.

Another arrangement of the blocks is to mak[e] them 6 inches wide as before, but to place half [a] chute block at each side of the chute and t[he] two other equally spaced blocks between the[m]. Three equally spaced floor blocks can then [be] used in the basin, one straddling the centerli[ne] and the others placed 6 inches on either side [of] the center block. The block nearest to the sidew[all] is therefore 3 inches from the sidewall. This [is] greater than the allowable minimum of $0.6\text{x}\frac{3}{8}$ [=] 0.225 foot$=2\frac{3}{4}$ inches. The proportion of t[he] basin width occupied by the floor blocks is $3\text{x}\frac{6}{36}$ [=] 0.50, a satisfactory figure. The total force [on] each floor block is $745\text{x}\frac{6}{12}=372$ pounds.

Arrangement of the blocks is up to the design[er]. Either arrangement given above would be [sat]isfactory.

Field Experience

The first SAF stilling basin was built in west[ern] Iowa in 1944. Since that time a considera[ble] number of SAF stilling basins have been bu[ilt]. The exact number is unknown to the wri[ter]; publications describing the design of the S[AF] stilling basin are readily available for use [by] anyone without restriction, and there is no [way] to determine how many stilling basins have b[een] built according to the SAF design.

The writer has seen a number of SAF stil[ling] basins and has had reports on the performa[nce] of other stilling basins. All reports received [by] the writer and all SAF stilling basins observed [by] him have shown satisfactory performance. [The] following field structures are known to [have] handled flows that approach the capacity for wh[ich] they were designed, so their performance wil[l be] described.

The most thorough and complete test of the [SAF] stilling basin was that performed by Willia[m O.] Ree (*16*) at the Stillwater (Okla.) Out[door] Hydraulic Laboratory of the Agricultural [Re]search Service. Mr. Ree concluded (*p.* [...]

> Tests of the St. Anthony Falls Stilling Basin [over] a 2-year period at the Stillwater Outdoor Hyd[raulic] Laboratory showed that the stilling basin wa[s] effective and completely satisfactory. Very [little] scour of the channel bed occurred. It sho[uld be] noted, however, that the bed material at the [point] of discharge was a rather firm clay. A sandy ma[terial] might have shown a little different result.
>
> . . . Splash was not an important problem.

Figure 2 shows this stilling basin.

If someone is unduly concerned regar[ding] erosion in sandy material, figure 3 shows a [SAF] stilling basin at the exit of a 48-inch diam[eter] closed conduit spillway located at an airfie[ld in] northwestern Florida. The soil at the si[te of] this structure is a clayey sand. No scour of [the] readily erodible bed material is evident.

n a monthly report, Glenn H. Baker, Soil servation Service engineering specialist, commented on a visit to Spruce Knob Lake, in W. Va., le in 1953, as follows:

At this visit I had an opportunity to observe the performance of the SAF type stilling basin in operation. During the inspection the gate was completely removed from the opening to the 26-inch diameter drain which caused the maximum planned discharge. The basin performed according to expectations almost exactly as indicated by the model test shown in Ohio. There was a minimum of erosion in the channel below the dam, and the other engineers were impressed with the operation of this type of structure.

model referred to was one developed for nstration purposes in which the pipe had a eter of 1½ inches—one-seventeenth the size e Spruce Knob Lake pipe.

e third structure that will be mentioned is F stilling basin at the end of a chute. This ay is located in Crawford County, Iowa. une 22, 1947, the storm runoff rate exceeded esign capacity of the spillway by 50 percent, figure being based on information made ble to the writer by Floyd Nimmo, conion engineer, through M. M. Culp, Chief, n and Construction Branch, Engineering on, U. S. Soil Conservation Service. Figure vs views of this structure taken before and he excessive storm of June 22, 1947. It is apparent from these photographs that the stilling basin gave excellent protection to ownstream channel despite the excessive hat passed through it.

FIGURE 2.—SAF stilling basin at Stillwater (Okla.) Outdoor Hydraulic Laboratory: *A*, Drawing of basin; *B*, with full-capacity flow.

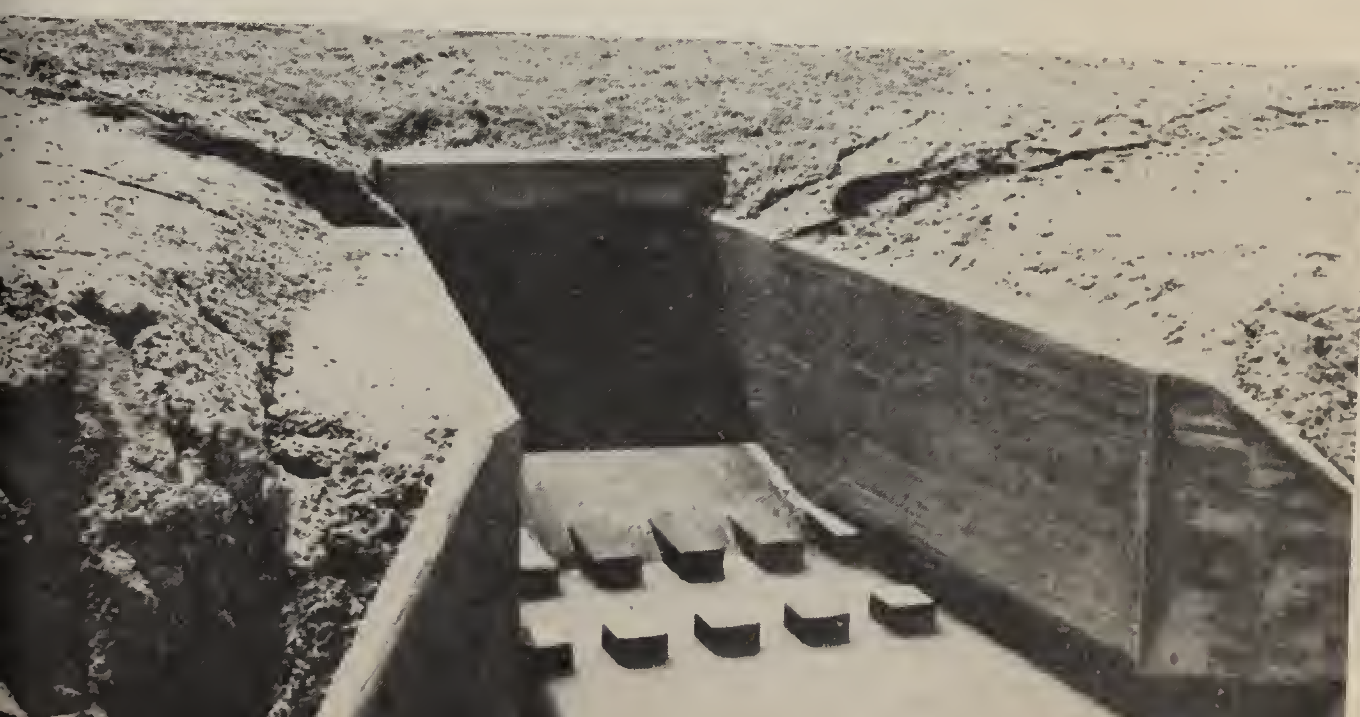


FIGURE 3.—SAF stilling basin at exit of 48-inch closed conduit spillway in northwestern Florida.

Figure 4.—Box inlet chute spillway and SAF stilling basin in Crawford County, Iowa: *A*, Before storm of June 22, 1947; *B*, after storm of June 22, when storm runoff rate exceeded design capacity by 50 percent.

E. I. Rowland, Arizona State Supervisor for the Bureau of Land Management, U. S. Department of the Interior, has furnished a number of interesting photographs of a SAF stilling basin (figs. 5 and 6). In a letter to the writer, dated October 31, 1955, Mr. Rowland writes:

> Enclosed are a few photographs of a drop structure placed across the San Simon Wash in southeastern Arizona. This is a replacement for an earlier design structure which was not adequate and washed out in 1954. This structure, known as the San Simon drop structure, has worked very successfully this year. The peak flow water stood at 6½' depth in the impounded area above the drop structure. The spillway lip is at elevation 88 feet (assumed) and the peak water within the reservoir was at 94½ foot stage. It was calculated that the maximum flow through the structure at this elevation was approximately 2,200 cfs.
>
> At this peak flow, the hydraulic jump in the box outlet, as indicated by the flow line of water through the lower structure was 13 feet above the floor of the structure at this point. The heavy splash line as indicated by the mud deposits on the side walls [fig. 6] reached 16 feet in height above the floor. The walls are 18 feet high at this point.
>
> It is extremely gratifying to note that the drop structure operated very effectively for volume flow reduction and reduced channel cutting. You will note in the picture [fig. 5,*B*], taken after all flow through the spillway had stopped on September 26, that there was no channel cutting, and practically no cutting around the lower wing walls except that which was caused by foreign drainage on the east wing, which will be corrected.
>
> Of most interest to us was the small sand fan which developed immediately below the lip of the structure and can be noted in the picture taken September 26 [fig. 5,*B*].

SUMMARY

The stilling basin developed as a result of the model studies at the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota has become known as the "SAF stilling basin." It has five distinct advantages:

1. The characteristics and proportions of the stilling basin have been determined over a wide range of conditions to be expected in the field; the performance can be predicted without making additional model studies.
2. The design procedure has been generalized.
3. The size of the stilling basin has been reduced to the minimum that will assure protection to the structure and prevent excessive erosion in the downstream channel.
4. The SAF stilling basin is very economical to construct.
5. Use of the SAF stilling basin under actual field conditions has demonstrated its effectiveness and has verified the predictions based on the laboratory tests.

A design chart, giving the proportions of the SAF stilling basin and the design equations and graphical solution of these equations, is presented on the center fold, pages 8 and 9.

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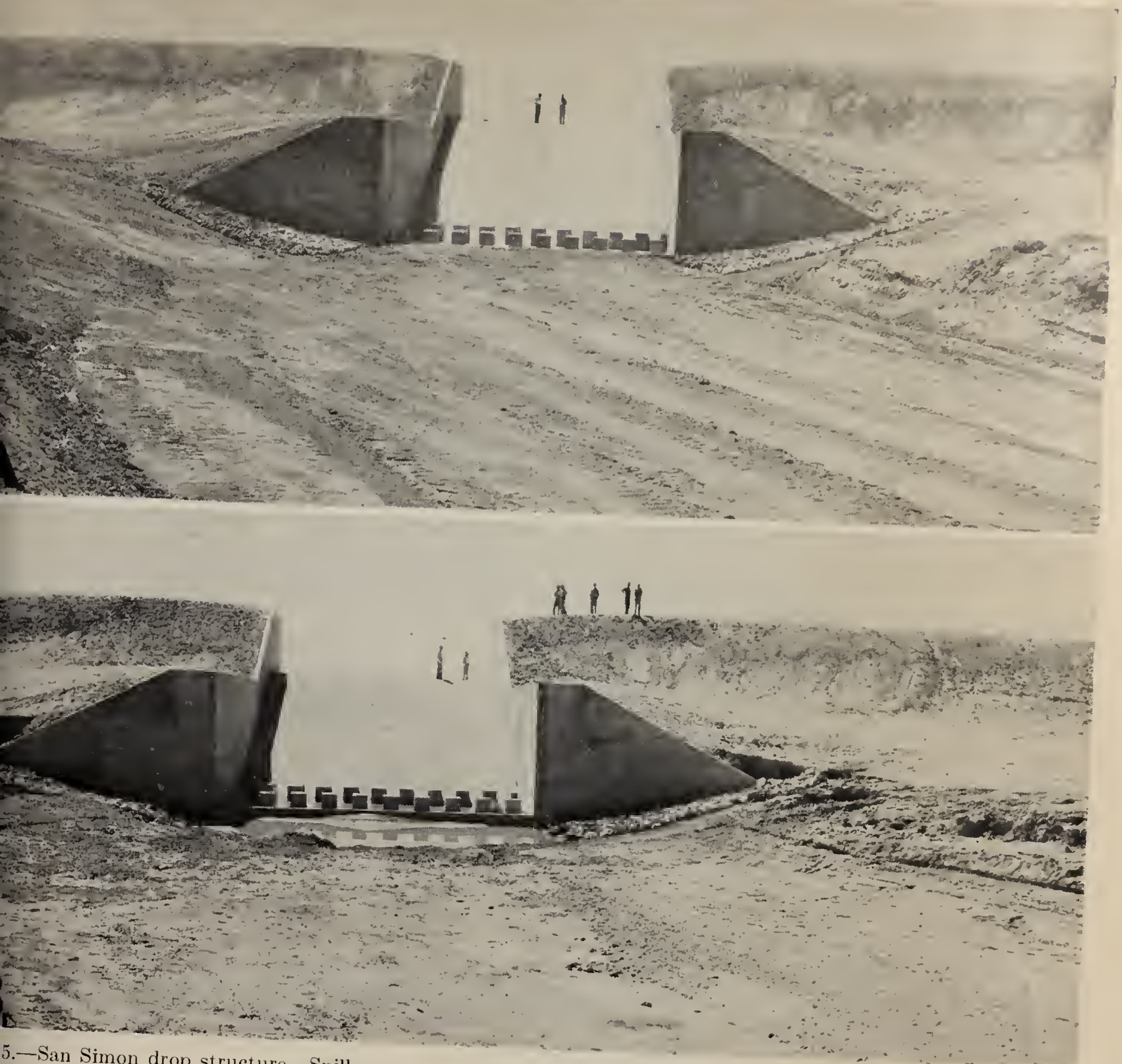

5.—San Simon drop structure—Spillway crest elevation is 88 feet; dam crest elevation, 103; end sill elevation, chute, 40 feet wide; and stilling basin sidewalls, 18 feet high: *A*, After completion of structure, July 10, 1955; *B*, after flow of 2,200 c. f. s., September 26, 1955.

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FIGURE 6.—Mud deposit on sidewalls of San Simon drop structure. The maximum flow line is 13 feet above the st[illing] basin floor, and the maximum splash line is about 16 feet above the basin floor. Photographed August 10, 1955.

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Grade Names

USED IN U.S. STANDARDS FOR FARM PRODUCTS

Agriculture Handbook No. 157
Revised February 1960

U. S. Department of Agriculture
Agricultural Marketing Service
Marketing Information Division
Washington, D. C.

INTRODUCTION

This publication lists grade names for all of the agricultural products for which United States standards have been issued. It was compiled from the official published standards and checked for accuracy by the commodity divisions issuing the standards. Standardization work is handled by the Cotton, Dairy, Fruit and Vegetable, Grain, Livestock, Poultry, and Tobacco Divisions of the Agricultural Marketing Service, U. S. Department of Agriculture. A complete list of all standards is contained in "Checklist of U. S. Standards for Farm Products," AMS-210, copies of which may be obtained from the Marketing Information Division, Agricultural Marketing Service, U. S. Department of Agriculture, Washington 25, D. C. Copies of the standards listed in this publication may be obtained from the individual commodity divisions issuing them.

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For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C.

GRADE NAMES USED IN U. S. STANDARDS FOR FARM PRODUCTS

COTTON AND COTTONSEED

Product	Grade Names												
tton,[1] Upland[2] ite	Strict* Good Middling	Good Middling	Strict Middling	Middling* Plus	Middling	Strict Low* Middling Plus	Strict Low Middling	Low* Middling Plus	Low Middling	Strict Good* Ordinary Plus	Strict Good Ordinary	Good* Ordinary Plus	Good Ordinary
ht Spotted	Good* Middling Light Spotted	Strict* Middling Light Spotted	Middling* Light Spotted	Strict* Low Middling Light Spotted	Low* Middling Light Spotted	-	-	-	-	-	-	-	-
ted	Good* Middling Spotted	Strict* Middling Spotted	Middling* Spotted	Strict* Low Middling Spotted	Low* Middling Spotted	-	-	-	-	-	-	-	-
ed	Good* Middling Tinged	Strict Middling Tinged	Middling Tinged	Strict Low Middling Tinged	Low Middling Tinged	-	-	-	-	-	-	-	-
w Stained	Good* Middling Yellow Stained	Strict* Middling Yellow Stained	Middling* Yellow Stained	-	-	-	-	-	-	-	-	-	-
	Good* Middling Gray	Strict* Middling Gray	Middling* Gray	Strict* Low Middling Gray	-	-	-	-	-	-	-	-	-
Gray	Good* Middling Light Gray	Strict* Middling Light Gray	Middling* Light Gray	Strict* Low Middling Light Gray	-	-	-	-	-	-	-	-	-
,[1] American ian	Grade No. 1	Grade No. 2	Grade No. 3	Grade No. 4	Grade No. 5	Grade No. 6	Grade No. 7	Grade No. 8	Grade No. 9	Grade* No. 10	-	-	-
,[1] Sea d	Grade No. 1	Grade* No. 1½	Grade No. 2	Grade* No. 2½	Grade No. 3	Grade* No. 3½	Grade No. 4	Grade* No. 4½	Grade No. 5	Grade* No. 5½	Grade No. 6	Below Grade No. 6*	-
seed for ing[3]	Prime Quality	Below Prime Quality	Off Quality	Below Grade	-	-	-	-	-	-	-	-	-
[4]	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Chemical Grade*	-	-	-	-	-

riptive grades--all others are practical forms.
ple lengths of $\frac{13}{16}$ and $\frac{7}{8}$ to $1\frac{3}{4}$ inches and above, in steps of $\frac{1}{32}$ inch, apply to all grades of American
, as found to be appropriate.
ective as of August 1, 1960.
lity index designations. Actual grades (quality and quanity indexes) are expressed numerically.
duated physical staple standards, 1 through 7, and one descriptive standard, "Below 7," apply to all
of American cotton linters.

DAIRY PRODUCTS

Product	Grade Names			
Butter	U.S. Grade AA (U.S. 93 Score)	U.S. Grade A (U.S. 92 Score)	U.S. Grade B (U.S. 90 Score)	U.S. Grade C (U.S. 89 Score)
Cheddar Cheese	U.S. Grade AA	U.S. Grade A	U.S. Grade B	U.S. Grade C
Dry Buttermilk	U.S. Extra	U.S. Standard	-	-
Dry Whole Milk	U.S. Premium	U.S. Extra	U.S. Standard	-
Dry Whey	U.S. Extra	-	-	-
Nonfat Dry Milk	U.S. Extra	U.S. Standard	-	-
Swiss Cheese	U.S. Grade A	U.S. Grade B	U.S. Grade C	U.S. Grade D

Product	Grade Names					
nise, Sweet (wholesale)	U. S. No. 1	-	-	-	-	-
pples (wholesale)	U. S. Extra* Fancy	U. S. Fancy*	U. S. No. 1*	U. S. No. 1 Cookers	U.S. No. 1 Early	U.S. * Utility	U.S. Hail grade
pples for Processing	U.S. No. 1	U. S. No. 2	-	-	-	-	-
ricots wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
tichokes wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
paragus wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
paragus, Green or Canning or reezing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
cados holesale)	U.S. No. 1	U.S. Combination	U.S. No. 2	U.S. No. 3	-	-	-
ns, ba (Fava) holesale)	U.S. No. 1	-	-	-	-	-	-
ns, ma holesale)	U.S. No. 1	U.S. Combination	U.S. No. 2	-	-	-	-
ns, Lima elled for ocessing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
s, Snap olesale)	U.S. Fancy	U.S. No. 1	U.S. Combination	U.S. No. 2	-	-	-
s, Snap Processing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
s olesale)	U.S. No. 1	U. S. No. 2	-	-	-	-	-
s Processing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Greens olesale)	U.S. No. 1	-	-	-	-	-	-
es for essing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
erries Processing	U.S. No. 1	U.S. No. 2	U.S. No. 3	-	-	-	-
oli, hed Italian uting lesale)	U.S. Fancy	U.S. No. 1	U.S. No. 2	-	-	-	-
oli for essing	U. S. No. 1	U.S. No. 2	-	-	-	-	-
li Italian ting umer grades)	U.S. Grade A	U.S. Grade B	-	-	-	-	-

binations of these grades may be used as follows: Combination U. S. Extra Fancy and U. S. Fancy, ation U. S. Fancy and U. S. No. 1, and Combination U. S. No. 1 and U. S. Utility.

Product	Grade Names						
Brussels Sprouts (wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Brussels Sprouts (consumer grades)	U.S. Grade A	U.S. Grade B	-	-	-	-	-
Cabbage (wholesale)	U.S. No. 1	U.S. Commercial	-	-	-	-	-
Cabbage for Processing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Cantaloups (wholesale)	U.S. No. 1	U.S. Commercial	-	-	-	-	-
Carrots, Bunched (wholesale)	U.S. No. 1	U.S. Commercial	-	-	-	-	-
Carrots, for Processing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Carrots (consumer grades)	U.S. Grade A	U.S. Grade B	-	-	-	-	-
Carrots, topped (wholesale)	U.S. Extra No. 1	U.S. No. 1	U.S. No. 2	-	-	-	-
Carrots, with short trimmed tops (wholesale)	U.S. No. 1	U.S. Commercial	-	-	-	-	-
Cauliflower (wholesale)	U.S. No. 1	-	-	-	-	-	-
Cauliflower for Processing	U.S. No. 1	-	-	-	-	-	-
Celery (wholesale)	U.S. Extra No. 1	U.S. No. 1	U.S. No. 2	-	-	-	-
Celery Stalks (consumer grades)	U.S. Grade AA	U.S. Grade A	U.S. Grade B	-	-	-	-
Cherries, Red Sour for Manufacture	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Cherries, Sweet	U.S. No. 1	U.S. Commercial	-	-	-	-	-
Cherries, Sweet for Canning or Freezing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Cherries, Sweet for Export for Sulphur Brining	U.S. No. 1	-	-	-	-	-	-
Collard or Broccoli Greens (wholesale)	U.S. No. 1	-	-	-	-	-	-
Corn, Green (wholesale)	U.S. Fancy	U.S. No. 1	U.S. No. 2	-	-	-	-
Corn, Husked on the Cob (consumer grades)	U.S. Grade A	U.S. Grade B	-	-	-	-	-
Corn, Sweet for Canning	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Cranberries (consumer grades)	U.S. Grade A	-	-	-	-	-	-

Product	Grade Names						
Cranberries for Processing	U.S. No. 1	-	-	-	-	-	-
Cucumbers	U.S. Fancy	U.S. Extra No. 1	U.S. No. 1 U.S. No. 1 Small U.S. No. 1 Large	U.S. No. 2	-	-	-
ucumbers, Greenhouse (wholesale)	U.S. Fancy	U.S. No. 1	U.S. No. 2	-	-	-	-
ucumbers, Pickling	U.S. No. 1	U.S. No. 2	U.S. No. 3	-	-	-	-
urrants for Processing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
andelion Greens (wholesale)	U.S. No. 1	-	-	-	-	-	-
ewberries and Blackberries wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
gplant wholesale)	U.S. Fancy	U.S. No. 1	U.S. No. 2	-	-	-	-
dive, Escarole r Chicory wholesale)	U.S. No. 1	-	-	-	-	-	-
rlic (wholesale)	U.S. No. 1	-	-	-	-	-	-
apes, American Eastern Type) unch (wholesale)	U.S. Fancy Table Grapes U.S. Fancy Table Mixed	U.S. No. 1 Table Grapes U.S. No. 1 Table Mixed	U.S. No. 1 Juice Grapes U.S. No. 1 Juice Mixed	-	-	-	-
pes, American astern Type) nch for Proces-ng and Freezing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
pes, juice uropean Type) holesale)	U.S. No. 1 Juice Grapes U.S. No. 1 Mixed Juice Grapes	U.S. No. 2 Juice Grapes U.S. No. 2 Mixed Juice Grapes	Unclassified Grapes	-	-	-	-
es, Sawdust k (European e) (wholesale)	U.S. Fancy Sawdust Pack Grapes	U.S. No. 1 Sawdust Pack Grapes	-	-	-	-	-
es, table ropean or ifera type) olesale)	U.S. Fancy Table Grapes	U.S. Extra No. 1 Table Grapes	U.S. No. 1 Table Grapes	-	-	-	-
efruit lifornia and zona) olesale)	U.S. Fancy	U.S. No. 1	U.S. Com-bination Grade	U.S. No. 2	U.S. No. 3	-	-

Product	Grade Names						
Grapefruit (Florida) (wholesale)	U.S. Fancy	U.S. No. 1 U.S. No. 1 Bright U.S. No. 1 Golden U.S. No. 1 Bronze U.S. No. 1 Russet	U.S. No. 2 U.S. No. 2 Bright U.S. No. 2 Russet	U.S. No. 3	-	-	-
Grapefruit (Texas) (wholesale)	U.S. Fancy	U.S. No. 1 U.S. No. 1 Bright U.S. No. 1 Bronze	U.S. Combination Grade	U.S. No. 2 U.S. No. 2 Russet	U.S. No. 3	-	-
Honey Dew and Honey Ball Melons (wholesale)	U.S. No. 1	U.S. Commercial	U.S. No. 2	-	-	-	-
Horseradish Roots (wholesale)	U.S. Fancy	U.S. No. 1	U.S. No. 2	-	-	-	-
Kale (consumer grades)	U.S. Grade A	U.S. Grade B	-	-	-	-	-
Kale (wholesale)	U.S. No. 1	U.S. Commercial	-	-	-	-	-
Lemons (wholesale)	U.S. No. 1	U.S. Combination Grade	U.S. No. 2	U.S. No. 3	-	-	-
Lettuce (wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Lettuce Greenhouse Leaf (wholesale)	U.S. Fancy	U.S. No. 1	-	-	-	-	-
Limes (Persian) Tahiti (wholesale)	U.S. No. 1	U.S. Combination	U.S. No. 2	-	-	-	-
Mushrooms (wholesale)	U.S. No. 1	-	-	-	-	-	-
Mustard Greens and Turnip Greens (wholesale)	U.S. No. 1	-	-	-	-	-	-
Nectarines (wholesale)	U.S. Fancy	U.S. Extra No. 1	U.S. No. 1	U.S. No. 2	-	-	-
Okra (wholesale)	U.S. No. 1	-	-	-	-	-	-
Onions, Bermuda-Granex	U.S. No. 1	U. S. Combination	U.S. No. 2	-	-	-	-
Onions, Common Green	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Onions, Creole (wholesale)	U.S. No. 1	U.S. No. 2 Combination	U.S. No. 2	-	-	-	-
Onions for Processing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Onions, Northern Grown (wholesale)	U.S. No. 1	U.S. No. 1 Boilers U.S. No. 1 Picklers	U.S. Commercial	U.S. No. 2	-	-	-

Product	Grade Names						
Onion Sets (wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Oranges, California & Arizona (wholesale)	U.S. Fancy	U.S. No. 1	U.S. Combination	U.S. No. 2	-	-	-
ranges, (Texas) (wholesale)	U.S. Fancy	U.S. No. 1 U.S. No. 1 Bright U.S. No. 1 Bronze	U.S. Combination	U.S. No. 2 U.S. No. 2 Russet	U.S. No. 3	-	-
ranges and Tangelos, Florida (wholesale)	U.S. Fancy	U.S. No. 1 Bright U.S. No. 1 U.S. No. 1 Golden U.S. No. 1 Bronze U.S. No. 1 Russet	U.S. No. 2 Bright U.S. No. 2 U.S. No. 2 Russet	U.S. No. 3	-	-	-
rsley (wholesale)	U.S. No. 1	-	-	-	-	-	-
rsnips (consumer rades)	U.S. Grade A	U.S. Grade B	-	-	-	-	-
rsnips vholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
ıches vholesale)	U.S. Fancy	U.S. Extra No. 1	U.S. No. 1	U.S. No. 2	-	-	-
ches (Freestone r Canning)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
ches (Freestone r Freezing or lping)	U.S. No. 1	U.S. No. 2	U.S. No. 3	-	-	-	-
rs for Canning	U.S. No. 1	U.S. No.2	-	-	-	-	-
rs Summer and ll (wholesale)	U.S. No. 1	U.S. Combination	U.S. No. 2	-	-	-	-
rs, Winter olesale)	U.S. Extra No. 1	U.S. No. 1	U.S. Combination	U.S. No. 2	-	-	-
, Fresh olesale)	U.S. Fancy	U.S. No. 1	-	-	-	-	-
, Fresh lled for ning or ezing	U.S. Fancy	U.S. No. 1	U.S. No. 2	U.S. No.3	-	-	-
, Southern olesale)	U.S. No. 1	U.S. Commercial	-	-	-	-	-
ers, Sweet lesale)	U.S. Fancy	U.S. No. 1	U.S. No. 2	-	-	-	-
rs, Sweet Processing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
pples lesale)	U.S. Fancy	U.S. No. 1	U.S. No. 2	-	-	-	-
and Prunes, h (wholesale)	U.S. Fancy	U.S. No. 1	U.S. Combination	U.S. No. 2	-	-	-

Product	Grade Names						
Potatoes (consumer grades)	U.S. Grade A Small U.S. Grade A Medium U.S. Grade A Medium to Large U.S. Grade A Large	U.S. Grade B Small U.S. Grade B Medium U.S. Grade B Medium to Large U.S. Grade B Large	-	-	-	-	-
Potatoes (wholesale)	U.S. Fancy	U.S. No. 1	U.S. Commercial	U.S. No. 2	-	-	-
Radishes (wholesale)	U.S. No. 1	U.S. Commercial	-	-	-	-	-
Raspberries (wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Raspberries for Processing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Rhubarb (Field Grown) (wholesale)	U.S. Fancy	U.S. No. 1	U.S. No. 2	-	-	-	-
Romaine (wholesale)	U.S. No. 1	-	-	-	-	-	-
Shallots, Bunched (wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Spinach (for Processing)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Spinach Leaves (consumer grades)	U.S. Grade A	U.S. Grade B	-	-	-	-	-
Spinach Leaves (wholesale)	U.S. Extra No. 1	U.S. No. 1	U.S. Commercial	-	-	-	-
Spinach Plants (wholesale)	U.S. No. 1	U.S. Commercial	-	-	-	-	-
Squash, Fall and Winter Type (wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Squash, Summer (wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Strawberries (wholesale)	U.S. No. 1	U.S. Combination	U.S. No. 2	-	-	-	-
Strawberries, Growers' Stock for Manufacture	U.S. No. 1	U.S. No. 2	U.S. No. 3	U.S. No. 4	-	-	-
Strawberries, Washed and Sorted for Freezing	U.S. No. 1	-	-	-	-	-	-
Sweetpotatoes (wholesale)	U.S. Extra No. 1	U.S. No. 1	U.S. Commercial	U.S. No. 2	-	-	-
Sweetpotatoes for Canning or Freezing	U.S. No. 1	-	-	-	-	-	-
Sweetpotatoes for Dicing or Pulping	U.S. No. 1	U.S. No. 2	-	-	-	-	-

Product	Grade Names						
Tangerines (wholesale)	U.S. Fancy	U.S. No. 1 U.S. No. 1 Bronze	U.S. No. 2 U.S. No. 2 Russet	U.S. No. 3	-	-	-
Tangerines (Florida) (wholesale)	U.S. Fancy	U.S. No. 1 U.S. No. 1 Bronze U.S. No. 1 Russet	U.S. No. 2 U.S. No. 2 Russet	U.S. No. 3	-	-	-
Tomatoes (consumer grades)	U.S. Grade A	U.S. Grade B	-	-	-	-	-
Tomatoes (wholesale)	U.S. No. 1	U.S. Combination	U.S. No. 2	U.S. No. 3	-	-	-
omatoes, Canning	U.S. No. 1	U.S. No. 2	-	-	-	-	-
omatoes, for Manufacture of Strained Tomato Products	U.S. No. 1	U.S. No. 2	-	-	-	-	-
omatoes, Green for Processing	U.S. No. 1	U.S. No. 2	-	-	-	-	-
omatoes Greenhouse wholesale)	U.S. Fancy	U.S. No. 1	U.S. No. 2	-	-	-	-
matoes Italian ype for Canning	U.S. No. 1	U.S. No. 2	-	-	-	-	-
rnips (consumer rades)	U.S. Grade A	U.S. Grade B	-	-	-	-	-
rnips or utabagas wholesale)	U.S. No. 1	U.S. No. 2	-	-	-	-	-
termelons	U.S. No. 1	U.S. Commercial	U.S. No. 2	-	-	-	-

Nuts and Special Products

Product	Grade Names						
Almonds, in the Shell	U.S. No. 1	U.S. No. 1 Mixed	U.S. No. 2	U.S. No. 2 Mixed	-	-	-
Almonds, Shelled	U.S. Fancy	U.S. Extra No. 1	U.S. No. 1	U.S. Select Sheller Run	U.S. Standard Sheller Run	U.S. No. 1 Whole and Broken	U.S. No. 1* Pieces
Asparagus Plumosis	U.S. Fancy	U.S. No. 1	U.S. Commercial	-	-	-	-
Christmas Trees	U.S. Premium	U.S. No. 1	U.S. No. 2	-	-	-	-
Filberts, in the Shell	U.S. No. 1	-	-	-	-	-	-
Peanuts, Cleaned Virginia type in the Shell	U.S. Jumbo Hand Picked	U.S. Fancy Hand Picked	-	-	-	-	-
Peanuts, Farmers' Stock Runner	U.S. No. 1	U.S. No. 2	U.S. No. 3	-	-	-	-
Peanuts, Farmers' Stock Virginia type	U.S. No. 1	U.S. No. 2	U.S. No. 3	-	-	-	-
Peanuts, Farmers' Stock White Spanish	U.S. No. 1	U.S. No. 2	U.S. No. 3	-	-	-	-
Peanuts, Shelled Runner type	U.S. No. 1 Runner	U.S. Runner Splits	U.S. No. 2 Runner	-	-	-	-
Peanuts, Shelled Spanish type	U.S. No. 1 Spanish	U.S. Spanish Splits	U.S. No. 2 Spanish	-	-	-	-
Peanuts, Shelled Virginia type	U.S. Extra Large Virginia	U.S. Medium Virginia	U.S. No. 1 Virginia	U.S. Virginia Splits	U.S. No.2 Virginia	-	-
Pecans, in the Shell	U.S. No. 1	U.S. Commercial	-	-	-	-	-
Pecans, Shelled	U.S. No. 1 Halves	U.S. Commercial Halves	U.S. No. 1 Pieces	U.S. Commercial Pieces	-	-	-
Peonies in the Bud	U.S. No. 1	U.S. No. 2	-	-	-	-	-
Tomato Plants	U.S. No. 1	-	-	-	-	-	-
Walnuts, Shelled English	U.S. No. 1	U.S. Commercial	-	-	-	-	-
Walnuts, in the Shell	U.S. No. 1	U.S. No. 2	U.S. No. 3	-	-	-	-

*Additional grades: U.S. No. 1 Mixed, U.S. Select Sheller Run Mixed, U.S. Standard Sheller Run Mixed, U.S. No. 1 Whole and Broken Mixed.

Product	Grade Names				
Apples, Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
Apples Dried	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard	-
Apples Dehydrated (low moisture)	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-	-
Apples Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
pple Butter Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
pple Juice Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-	-
pplesauce Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-	-
pricots Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D	Substandard
pricots ehydrated ow-moisture	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-	-
ricots ried	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
ricots rozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
ricots r Manufac-ring Frozen	U.S. Grade A for Manufacturing or U.S. Fancy Grade for Manufacturing	U.S. Grade B for manufacturing or U.S. Choice Grade for Manufacturing	U.S. Grade D for manufacturing or Substandard for Manufacturing	-	-
aragus nned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
aragus ozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-	-
s, Dried ned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-	-
s en and Wax ned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard	-
s, Green Wax Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard	-

Product	Grade Names			
Beans, Lima Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard
Beans, Lima Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard
Beets, Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-
Berries Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade D or Substandard	-
Berries, Frozen for Manufacturing	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade D or Substandard	-
Blackberries and other Similar Berries Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard
Blueberries Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard
Blueberries Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard
Broccoli Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade D or Substandard	-
Brussels Sprouts Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard
Carrots Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-
Carrots, Diced Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-
Cauliflower Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-
Cherries, Red Sour Pitted Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
Cherries, Red Sour Pitted Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
Cherries, Sweet Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard
Cherries, Sweet Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-

Product	Grade Names			
hili Sauce Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-
orn, Cream Style Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard
rn-on-the-cob rozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-
rn, Whole Kernel anned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard
rn, Whole Kernel rozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard
nberry Sauce nned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
rants ied	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-
es	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice U.S. Grade B (Dry) or U.S. Choice (Dry)	U.S. Grade C or U.S. Standard U.S. Grade C (Dry) or U.S. Standard (Dry)	Substandard
, Kadota ned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard
ed	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard
t Cocktail ned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-
Jelly	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade D or Substandard	-
Preserves (or)	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-
s for Salad ed	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Off-grade	-
Juice ed	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade D or Substandard	-
Juice Concentrate ened n	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-
ruit d	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Broken	Substandard

Product	Grade Names			
Grapefruit Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Broken	U.S. Grade D or Substandard
Grapefruit and Orange for salad Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Broken	U.S. Grade D or Substandard
Grapefruit Juice Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-
Grapefruit Juice Concentrated Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-
Grapefruit Juice Dehydrated	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-
Grapefruit Juice and Orange Juice Blended Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-
Grapefruit Juice and Orange Juice, Concentrated, Blended Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-
Grapefruit Juice for Manufacturing Canned	U.S. Grade A for Manufacturing or U.S. Fancy for Manufacturing	U.S. Grade C for Manufacturing or U.S. Standard for Manufacturing	Substandard for Manufacturing	-
Hominy, Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-
Leafy Greens (other than Spinach) Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-
Lemon Juice Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Off-grade	-
Lemon Juice, Concentrated for Manufacturing	U.S. Grade A for Manufacturing or U.S. Fancy for Manufacturing	U.S. Grade C for Manufacturing or U.S. Standard for Manufacturing	Substandard for Manufacturing	-
Lemonade, Concentrate Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-
Limeade, Concentrate Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-
Mushrooms Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-
Okra Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-
Okra Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade D or Substandard	-

Product	Grade Names				
)kra and Tomatoes Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
)lives, Green Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
lives, Ripe Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Off-grade	-
nion Rings, 3readed, Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-	-
ions anned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
ange Juice anned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
ange Juice hilled	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-	-
nge Juice hydrated	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-	-
nge Juice ncentrated anned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
nge Juice ncentrated ozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-	-
ge Juice ncentrated for ufacturing nned	U.S. Grade A for Manufacturing or U.S. Fancy for Manufacturing	U.S. Grade C for Manufacturing or U.S. Standard for Manufacturing	Substandard for Manufacturing	-	-
ge Marmalade	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade D or Substandard	-	-
hes ydrated -moisture	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-	-
nes ed	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
es en	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
es, Frozen Manufac- ng	U.S. Grade A for Manufacturing or U.S. Fancy Grade for Manufacturing	U.S. Grade B for Manufacturing or U.S. Choice Grade for Manufacturing	U.S. Grade D for Manufacturing or Substandard for Manufacturing	-	-
es, stone d	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D	Substandard

Product	Grade Names				
Peaches, Freestone Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D	Substandard
Pears, Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard	-
Pears, Dried	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
Peas Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard	-
Peas Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
Peas and Carrots Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard	-
Peas, Field and Blackeye Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-	-
Peas, Field and Blackeye Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-	-
Peppers, Sweet Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-	-
Pickles, Cucumber Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-	-
Pimientos Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
Pineapple Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard	-
Pineapple Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
Pineapple Juice	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
Plums Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D	Substandard
Plums Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	Substandard	-	-

Product	Grade Names				
Potatoes, French Fried Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-	-
Potatoes, White Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-	-
Prunes, Dried Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
Prunes Dried	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard	-
Pumpkin and Squash Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
aisins Processed	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard	-
aspberries Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard	-
aspberries Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade D or Substandard	-	-
aspberries Frozen for Manufacturing	U.S. Grade A for Manufacturing or U.S. Fancy for Manufacturing	U.S. Grade B for Manufacturing or U.S. Choice for Manufacturing	-	-	-
ubard rozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade D or Substandard	-	-
uerkraut anned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard	-
inach anned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-	-
inach rozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-	-
uash (Cooked) rozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-	-
uash (Summer ype) Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
uash (Summer ype) Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-	-

Product	Grade Names				
Strawberries Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard	-
Succotash Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Off-grade	-
Succotash Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard	-
Sweetpotatoes Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-	-
Tangerine Juice Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-	-
Tangerine Juice Concentrated for Manufacturing Canned	U.S. Grade A for Manufacturing or U.S. Fancy for Manufacturing	U.S. Grade C for Manufacturing or U.S. Standard for Manufacturing	Substandard for Manufacturing	-	-
Tomatoes Canned	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
Tomato Catsup	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard	-
Tomato Juice Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
Tomato Paste Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-	-
Tomato Puree (Tomato Pulp) Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-	-
Tomato Sauce Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
Tomatoes and Okra Canned	U.S. Grade A or U.S. Fancy	U.S. Grade C or U.S. Standard	Substandard	-	-
Turnip Greens with Turnips Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-	-
Vegetables, Mixed Frozen	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	U.S. Grade C or U.S. Standard	Substandard	-

Honey and Sugar Products

Product	Grade Names				
Honey, Comb-section	United States Fancy	United States No. 1	United States No. 1 Mixed Color	United States No. 2	Unclassified
Honey, Shallow-frame Comb	United States Fancy	United States No. 1	Unclassified	-	-
Honey, Wrapped Cut-Comb	United States Fancy	United States No. 1	-	-	-
Honey, Chunk or Bulk Comb	United States Fancy	United States No. 1	Unclassified	-	-
Honey, Extracted	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard	-
Maple Sirup for Re-Processing	U.S. Grade AA (Fancy) Maple Sirup for Re-Processing	U.S. Grade A Maple Sirup for Re-Processing	U.S. Grade B Maple Sirup for Re-Processing	U.S. Grade C Maple Sirup for Re-Processing	Unclassified Maple Sirup for Re-Processing
Maple, Sirup, Table	U.S. Grade AA (Fancy) Table Maple Sirup	U.S. Grade A Table Maple Sirup	U.S. Grade B Table Maple Sirup	Unclassified Table Maple Sirup	-
Molasses, Sugarcane	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard	-
Refiners' Sirup	U.S. Fancy or U.S. Grade A Refiners' Sirup	U.S. Choice or U.S. Grade B Refiners' Sirup	U.S. Extra Standard or U.S. Grade C Refiners' Sirup	U.S. Standard or U.S. Grade D Refiners' Sirup	U.S. Sub-standard or U.S. Grade E Refiners' Sirup
Sugarcane Sirup	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	Substandard	-

Miscellaneous Processed Products

Sulphured Cherries	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade D or Seconds	U.S. Combination Grade
Olive Oil	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Choice	U.S. Grade C or U.S. Standard	U.S. Grade D or Substandard
Olives, Salt Cured Oil Coated	U.S. No. 1	Unclassified	-	-
Olives, Processed Sicilian Style	U.S. No. 1	Unclassified	-	-
Peanut Butter	U.S. Grade A	U.S. Grade C	Off-grade	-
Potatoes, Peeled	U.S. Grade A or U.S. Fancy	U.S. Grade B or U.S. Extra Standard	Substandard	-
Sauer Kraut, Bulk	U.S. Grade A (First Quality)	U.S. Grade C (Second Quality)	Off-grade (Substandard)	-

GRAIN

(Including Soybeans)

Product	Grade Names						
Barley (Barley, Malting Barley, Blue Malting Barley, Western Barley, and Mixed Barley)	1	2	3	4	5	Sample Grade	-
	Note: Only Grades No. 1, 2, and 3 apply to Malting Barley and Blue Malting Barley.						
	(Special grades, when applicable, are Test Weight Western, Tough, Two-rowed, Choice Malting Two-rowed Western, Malting Two-rowed Western, Bright Western, Stained Western, Blighted, Smutty, Garlicky, Weevily, Ergoty, Bleached)						
Corn (Yellow corn, White corn, Mixed corn)	1	2	3	4	5	Sample Grade	-
	(Special grades, when applicable, are Flint corn, Flint and Dent corn, Weevily corn)						
Flaxseed	1	2	Sample grade	-	-	-	-
Grain, Mixed	Mixed Grain	Sample grade Mixed Grain	-	-	-	-	-
	(Special grades, when applicable, are Tough, Smutty, Ergoty, Garlicky, Weevily, Blighted, Treated)						
Grain Sorghums (White, Yellow, Red, Brown, Mixed)	1	2	3	4	Sample grade	-	-
	(Special grades, when applicable, are Bright Grain Sorghums, Discolored Grain Sorghums, Weevily Grain Sorghums, Smutty Grain Sorghums)						
Oats (White oats, Red oats, Gray oats, Black oats, Mixed oats)	1	2	3	4	Sample grade	-	-
	(Special grades, when applicable, are Bright Oats, Heavy Oats, Extra Heavy Oats, Tough Oats, Thin Oats, Bleached Oats, Weevily Oats, Smutty Oats, Ergoty Oats, Garlicky Oats)						
Rye	1	2	3	4	Sample grade	-	-
	(Special grades, when applicable, are Plump, Tough, Smutty, Garlicky, Weevily, Ergoty)						
Soybeans (Yellow, Green, Brown, Black, and Mixed)	1	2	3	4	Sample grade	-	-
	(Special grades, when applicable, are Garlicky, Weevily)						
Wheat (Hard Red Spring Wheat, Durum Wheat, Red Durum Wheat, Hard Red Winter Wheat, Soft Red Winter Wheat, White Wheat, Mixed Wheat)	1 Heavy (applies only to Hard Red Spring Wheat)						
	1	2	3	4	5	Sample grade	-
	(Special grades, when applicable, are Tough, Smutty, Garlicky, Weevily, Ergoty, Treated)						

Beans, Peas, and Rice

Product	Grade Names						
eans (including Pea beans, Medium white beans, Marrow beans, Great Northern beans, Small white beans, Flat small white beans, Large white beans, White kidney beans, Light red kidney beans, Dark red kidney beans, Western red kidney beans, Yelloweye beans, Old Fashioned yelloweye beans, Small red beans, Pink beans, Bayo beans, Mung beans, Blackeye beans, Cranberry beans, Pinto beans, Large lima beans, Baby lima beans, Miscellaneous lima beans Miscellaneous beans, Mixed beans)	U.S. No. 1	U.S. No. 2	U.S. No. 3	U.S. Sub-standard	U.S. Sample Grade	-	-
	Special grades: U.S. Extra No. 1--applies only to Baby, Large, and Miscellaneous lima beans. Choice handpicked and handpicked: applies to all beans except Blackeye, Cranberry, Baby lima, Large lima, Miscellaneous lima, and Mixed beans. High moisture and Off-color: applies to all beans when applicable.						
ntils	U.S. No. 1	U.S. No. 2	U.S. Sample grade	-	-	-	-
as, Dry	U.S. No. 1	U.S. No. 2	U.S. No. 3	U.S. Sample grade	-	-	-
	(Special grades, when applicable, are Large peas and Small peas)						
as, Split	U.S. No. 1	U.S. No. 2	U.S. No. 3	U.S. Sample grade	-	-	-
	(Special grades, when applicable, are Winter split peas and Split pea chips)						
e, Rough (Rexoro, Patna, lue Bonnet, Nira, Fortuna, lue Rose, Magnolia, Zenith, alrose, Early Prolific, Pearl, ixed)	U.S. No. 1	U.S. No. 2	U.S. No. 3	U.S. No. 4	U.S. No. 5	U.S. No. 6	U.S. Sample grade
	(Special grades, when applicable, are Damp rough rice and Weevily rough rice)						
e, Brown (Classes same as for ough rice)	U.S. No. 1	U.S. No. 2	U.S. No. 3	U.S. No. 4	U.S. Sample grade	-	-
e, Milled (Classes same as or rough and brown rice, plus econd Head, Screenings, and rewers)	U.S. No. 1	U.S. No. 2	U.S. No. 3	U.S. No. 4	U.S. No. 5	U.S. No. 6*	U.S. Sample grade
	(Special grades, when applicable, are Unpolished milled rice, Parboiled milled rice, Coated milled rice)						

Does not apply to Second Head, Screenings, and Brewers milled rice.)

Hay and Straw

Product	Grade Names			
Hay (Alfalfa and Alfalfa Mixed; Cowpea and Cowpea Mixed; Grass; Grain, Wild Oat, Vetch, and Grain Mixed; Johnson and Johnson Mixed; Lespedeza and Lespedeza Mixed; Mixed; Peanut and Peanut Mixed; Prairie; Soybean and Soybean Mixed; Timothy and Clover.)	U.S. No. 1	U.S. No. 2	U.S. No. 3	U.S. Sample Grade
	(Special grades, when applicable, are Extra Leafy Hay, Leafy Hay, Extra Green Hay, Green Hay, Coarse Hay, Fine Hay, and Stemmy Hay)			
Straw	U.S. No. 1	U. S. No. 2	U. S. Sample Grade	-
	(Special grades are Straight Rye Straw, Long Rye Straw, Chaffy Straw.)			

LIVESTOCK, MEAT, AND WOOL

(Including Hides and Skins)

Product	Grade Names							
IDES Cattle Hides Butcher & Country Green Salted (tentative grades)	No. 1	No. 2	No. 3	Reject	-	-	-	-
Calfskins and Green Salted Kips (tentative grades)	No. 1	No. 2	No. 3	No. 4	-	-	-	-
VE ANIMALS Cattle Bulls	Choice	Good	Commercial	Utility	Cutter	Canner	-	-
Stags	Choice	Good	Commercial	Utility	Cutter	Canner	-	-
Steers, Heifers, and Cows*	Prime	Choice	Good	Standard	Commercial	Utility	Cutter	Canner
Vealers and Calves	Prime	Choice	Good	Standard	Utility	Cull	-	-
'eeder & Stocker Cattle (tentative rades) Cows	Fancy	Choice	Good	Medium	Common	Inferior	-	-
Heifers	Fancy	Choice	Good	Medium	Common	Inferior	-	-
Steers	Fancy	Choice	Good	Medium	Common	Inferior	-	-
ambs and Sheep Lambs	Prime	Choice	Good	Utility	Cull	-	-	-
Sheep	Choice	Good	Utility	Cull	-	-	-	-
Yearlings	Prime	Choice	Good	Utility	Cull	-	-	-
ine Barrows and Gilts	U.S. No. 1	U.S. No. 2	U.S. No. 3	Medium	Cull	-	-	-
Sows	U.S. No. 1	U.S. No. 2	U.S. No. 3	Medium	Cull	-	-	-
ef, Calf, & al Bull	Choice	Good	Commercial	Utility	Cutter	Canner	-	-
Stag	Choice	Good	Commercial	Utility	Cutter	Canner	-	-
Steer, Heifer, and Cow**	Prime	Choice	Good	Standard	Commercial	Utility	Cutter	Canner
Veal and Calf	Prime	Choice	Good	Standard	Utility	Cull	-	-
mb and Mutton Lamb	Prime	Choice	Good	Utility	Cull	-	-	-
Mutton	Choice	Good	Utility	Cull	-	-	-	-
earling Mutton	Prime	Choice	Good	Utility	Cull	-	-	-
rk arrows and Gilts	U.S. No. 1	U.S. No. 2	U.S. No. 3	Medium	Cull	-	-	-
ows	U.S. No. 1	U.S. No. 2	U.S. No. 3	Medium	Cull	-	-	-

aughter cows are not eligible for the Prime grade.
ow beef is not eligible for the Prime grade.

LIVESTOCK, MEAT, AND WOOL

(Including Hides and Skins)

Product	Grade Names													
MOHAIR (proposed grades)	Grade 40's	Grade 36's	Grade 32's	Grade 28's	Grade 24's	Grade 20's	Grade 16's	-	-	-	-	-	-	-
WOOL Grease Wool	Grade 80's or Fine	Grade 70's or Fine	Grade 64's or Fine	Grade 60's or $\frac{1}{2}$ Blood	Grade 58's or $\frac{1}{2}$ Blood	Grade 56's or $\frac{3}{8}$ Blood	Grade 50's or $\frac{1}{4}$ Blood	Grade 48's or $\frac{1}{4}$ Blood	Grade 46's or Low $\frac{1}{4}$ Blood	Grade 44's or Common	Grade 40's or Braid	Grade 36's or Braid	-	-
Wool Top	Grade 80's	Grade 70's	Grade 64's	Grade 62's	Grade 60's	Grade 58's	Grade 56's	Grade 54's	Grade 50's	Grade 48's	Grade 46's	Grade 44's	Grade 40's	Grade 36's

POULTRY AND POULTRY PRODUCTS

(Including Rabbits)

Product	Grade Names					
...ell Eggs, consumer grades	Fresh Fancy Quality or U.S. Grade AA*	U.S. Consumer Grade AA	U.S. Grade A*	U.S. Consumer Grade A	U.S. Con. sumer Grade B	U.S. Consumer Grade C
...ell Eggs, wholesale grades	U.S. Special __% AA Quality	U.S. Extras __% A Quality	U.S. Standard__% B Quality	U.S. Trades __% C Quality	U.S. Dirties	U.S. Checks
...ell Eggs, procurement grades	U.S. Procurement Grade I	U.S. Procurement Grade II	U.S. Procurement Grade III	U.S. Procurement Grade IV	-	-
...ell Eggs, export grades	U.S. Export Grade I or U.S. Export Grade A	U.S. Export Grade II	U.S. Export Grade III	U.S. Export Grade IV	-	-
...ltry, Live (chickens, ...rkeys, ducks, geese, ...ineas, pigeons)	U.S. No. 1 or U.S. Grade A	U.S. No. 2 or U.S. Grade B	U.S. No. 3 or U.S. Grade C	-	-	-
...ltry, Dressed and Ready-to-...ok (chickens, turkeys, ducks, ...ese, guineas, pigeons) ...olesale and consumer grades	U.S. Grade A	U.S. Grade B	U.S. Grade C	-	-	-
...bits, Domestic, Ready-to-...ok	U.S. Grade A	U.S. Grade B	U.S. Grade C	-	-	-

...ith boxed statement-- PRODUCED AND MARKETED UNDER FEDERAL - STATE QUALITY CONTROL PROGRAM

Product	Grade Names					
FLUE-CURED TOBACCO (U.S. Types 11, 12, 13, and 14) *						
Wrapper Grades (A-group)	A1F A1R	A2F A2R	- -	- -	- -	- -
Leaf Grades (B-group)	B1L B1F B1R - - - -	B2L B2F B2R - - - -	B3L B3F B3R B3D B3K B3M B3G	B4L B4F B4R B4D B4K B4M B4G	B5L B5F B5R B5D B5K B5M B5G	B6L B6F B6R B6D B6K B6M B6G
Cutter Grades (C-group)	C1L C1F - -	C2L C2F - -	C3L C3F - -	C4L C4F C4K -	C5L C5F C5K C5M	- - - -
Lug Grades (X-group)	X1L X1F - - -	X2L X2F - - -	X3L X3F - X3M X3G	X4L X4F X4K X4M X4G	X5L X5F X5K X5M X5G	- - - - -
Nondescript Grade (N-group)	N1L N1F N1R N1G	N2 - - -	- - - -	- - - -	- - - -	- - - -
Scrap Grade (S-group)	S	-	-	-	-	-
FIRE-CURED TOBACCO (U.S. Type 21)						
Wrapper Grades ** (A-group)	A1F A1D	A2F A2D	- -	- -	- -	- -
Heavy Leaf Grades (B-group) **	B1F B1D - -	B2F B2D - -	B3F B3D B3M B3G	B4F B4D B4M B4G	B5F B5D B5M B5G	- - - -
Thin Leaf Grades (C-group) **	C1L C1F - - - -	C2L C2F C2D - - -	C3L C3F C3D C3M C3K C3G	C4L C4F C4D C4M C4K C4G	C5L C5F C5D C5M C5K C5G	- - - - - -
Lug Grades (X-group) ** **	X1L X1F X1D - -	X2L X2F X2D - -	X3L X3F X3D X3M X3G	X4L X4F X4D X4M X4G	X5L X5F X5D X5M X5G	- - - - -

*Deviations from the standard grades are sometimes authorized to show peculiar sides or characteristics not covered by the specifications for grades. Special factors, such as U and W, are used to indicate such deviations as limited damage and excessive moisture.

**Length is stated in connection with each grade of the A, B, and C groups. For this purpose U. S. Standard 4-Inch Sizes are used: U. S. Sizes 43, 44, 45, 46, and 47. Tobacco of X3, X4, and X5 qualitie in M and G colors which exceeds 20 inches in length is designated by size 45.

Product	Grade Names					
Nondescript Grades (N-group)	N1L N1D N1G	N2 - -	- - -	- - -	- - -	- - -
Scrap Grade (S-group)	S	-	-	-	-	-
RE-CURED TOBACCO .S. Types 22, 23, and) *						
rapper Grades ** (A-group)	A1F A1D	A2F A2D	A3F A3D	- -	- -	- -
eavy Leaf Grades (B-group) **	B1F B1D - -	B2F B2D - -	B3F B3D B3M B3G	B4F B4D B4M B4G	B5F B5D B5M B5G	- - - -
in Leaf Grades (C-group) **	C1L C1F - - -	C2L C2F C2D - -	C3L C3F C3D C3M C3G	C4L C4F C4D C4M C4G	C5L C5F C5D C5M C5G	- - - - -
ort Leaf or Tip Grades T-group)	- - - -	- - - -	T3F T3D T3M T3G	T4F T4D T4M T4G	T5F T5D T5M T5G	- - - -
g Grades -group)	X1L X1F X1D - -	X2L X2F X2D - -	X3L X3F X3D X3M X3G	X4L X4F X4D X4M X4G	X5L X5F X5D X5M X5G	- - - - -
ndescript and Scrap Grades N and S groups)			(grades are N and S)			
Y TOBACCO . Type 31) * yings Grades -group)	X1L X1F - - -	X2L X2F - - -	X3L X3F X3R - -	X4L X4F X4R X4M X4G	X5L X5F X5R X5M X5G	- - - - -
or Cutter Grades -group)	C1L C1F - - - - -	C2L C2F - - - - -	C3L C3F C3R C3K C3M C3V	C4L C4F C4R C4K C4M C4V C4G	C5L C5F C5R C5K C5M C5V C5G	- - - - - - -
Grades group)	B1F B1FR B1R - - - - - - -	B2F B2FR B2R - - - - - - -	B3F B3FR B3R - B3K B3M B3VF B3VR B3GF B3GR	B4F B4FR B4R B4D B4K B4M B4VF B4VR B4GF B4GR	B5F B5FR B5R B5D B5K B5M B5VF B5VR B5GF B5GR	- - - - - - - - - -

ations from the standard grades are sometimes authorized to show peculiar sides or characteris-
t covered by the specifications for grades. Special factors, such as U and W, are used to indi-
ch deviations as limited damage and excessive moisture.
th is stated in connection with each grade of the A, B, and C groups of Fire-Cured tobacco. For
rpose U. S. Standard 4-Inch Sizes are Used: U. S. Sizes 43, 44, 45, and 46.

Product	Grade Names				
Tips Grades (T-group)	-	-	T3F	T4F	T5F	-
	-	-	T3FR	T4FR	T5FR	-
	-	-	T3R	T4R	T5R	-
	-	-	-	T4D	T5D	-
	-	-	-	T4K	T5K	-
	-	-	-	T4VF	T5VF	-
	-	-	-	T4VR	T5VR	-
	-	-	-	T4GF	T5GF	-
	-	-	-	T4GR	T5GR	-
Mixed Group Grades (M-group)	-	-	M3F	M4F	M5F	-
	-	-	M3R	M4R	M5R	-
Nondescript Grades (N-group)	N1L	N2L	-	-	-	-
	N1F	-	-	-	-	-
	N1R	N2R	-	-	-	-
	N1G	N2G	-	-	-	-
Scrap Grade (S-group)	S	-	-	-	-	-
MARYLAND TOBACCO (U.S. Type 32) *						
Ground Leaf Grades (P-group)	-	-	P3L	P4L	P5L	-
	-	-	P3F	P4F	P5F	-
	-	-	-	P4R	P5R	-
Seconds Grades (X-group)	X1L	X2L	X3L	X4L	X5L	-
	X1F	X2F	X3F	X4F	X5F	-
	-	-	X3R	X4R	X5R	-
	-	-	-	X4D	X5D	-
	-	-	X3K	X4K	X5K	-
	-	-	X3V	X4V	X5V	-
	-	-	-	X4G	X5G	-
Bright-crop or Thin-crop Grades (C-group)	C1L	C2L	C3L	C4L	C5L	-
	C1F	C2F	C3F	C4F	C5F	-
	-	-	C3R	C4R	C5R	-
	-	-	-	C4D	C5D	-
	-	-	C3K	C4K	C5K	-
	-	-	C3V	C4V	C5V	-
	-	-	-	C4G	C5G	-
Dull-Crop or Heavy-crop Grades (B-group)	B1F	B2F	B3F	B4F	B5F	-
	B1R	B2R	B3R	B4R	B5R	-
	-	-	B3D	B4D	B5D	-
	-	-	B3K	B4K	B5K	-
	-	-	B3V	B4V	B5V	-
	-	-	B3G	B4G	B5G	-

*Deviations from the standard grades are sometimes authorized to show peculiar sides or characteris-tics not covered by specifications for the grades. Special factors, such as U and W, are used to indi-cate such deviations as limited damage and excessive moisture.

Product	Grade Names					
Tip Grades (T-group)	- - - - - -	- - - - - -	T3F T3R - - - -	T4F T4R T4D T4K T4V T4G	T5F T5R T5D T5K T5V T5G	- - - - - -
Nondescript Grades (N-group)	N1L N1F N1R N1G	N2 - - -	- - - -	- - - -	- - - -	- - - -
Scrap Grade (S-group)	S	-	-	-	-	-
ARK AIR-CURED TOBACCO (U.S. Types 35, 36, and 37) *						
Wrapper Grades (A-group) **	A1F A1R	A2F A2R	A3F A3R	- -	- -	- -
Heavy Leaf Grades (B-group) **	B1F B1R B1D - -	B2F B2R B2D - -	B3F B3R B3D B3M B3G	B4F B4R B4D B4M B4G	B5F B5R B5D B5M B5G	- - - - -
Thin Leaf Grades (C-group) **	C1L C1F C1R - -	C2L C2F C2R - -	C3L C3F C3R C3M -	C4L C4F C4R C4M C4G	C5L C5F C5R C5M C5G	- - - - -
hort Leaf and Tip Grades (T-group)	- - - - -	- - - - -	T3F T3R T3D T3M T3G	T4F T4R T4D T4M T4G	T5F T5R T5D T5M T5G	- - - - -
ug Grades (X-group)	X1L X1F X1R - - -	X2L X2F X2R - - -	X3L X3F X3R X3D X3M X3G	X4L X4F X4R X4D X4M X4G	X5L X5F X5R X5D X5M X5G	- - - - - -
ndescript and Scrap Grades N and S group)			(grades are N and S)			

eviations from the standard grades are sometimes authorized to show peculiar sides or characteris-
not covered by the specifications for the grades. Special factors, such as U and W, are used to
cate such deviations as limited damage and excessive moisture.
Length is stated in connection with each grade of A, B, and C groups of Dark Air-Cured tobacco. For
purpose U. S. Standard 4-Inch Sizes are used: U. S. Sizes 43, 44, 45, and 46.

Product	Grade Names					
PENNSYLVANIA SEEDLEAF TOBACCO (U.S. Type 41) * tentative grades						
Stripper Grades (C-group) **	C1	C2	C3	C4	C5	-
Crop-run Grades (X-group)	X1	X2	X3	X4	X5	-
Farm-filler Grades (Y-group)	Y1	Y2	Y3	-	-	-
Nondescript (N-group)			(grade is N)			
OHIO CIGAR LEAF TOBACCO (U.S. Types 42, 43, and 44) * tentative grades						
Stripper Grades (C-group)	C1M	C2M	C3M	C4M	-	-
Crop-run Grades (X-group)	X1	X2	X3	X4	X5	-
Farm-filler Grades (Y-group)	Y1	Y2	Y3	-	-	-
Nondescript (N-group)			(grade is N)			

Product	Grade Names						
PUERTO RICAN-CIGAR LEAF TOBACCO (U.S. Type 46) * tentative grades Stripper Grades (C-group)	C1F C1P C1M - -	C2F C2P - - -	C3F C3P C3M C3T C3S	- - - - -	- - - - -	- - - - -	- - - - -
Filler and Grinder Grades (X and Y groups)	X1F X1P - - Y1	X2F X2P X2PT - Y2S	X3F X3P - X3S -	X4 - - - -	- - - - -	- - - - -	- - - - -
Nondescript and Scrap Grades (N and S groups)			(grades are N, S2, and S3)				
UNSORTED BROADLEAF TOBACCO (Type 51) tentative grades Unsorted Binder Grades (B-group)	B1M	B2M	B3M	B4M	B5M	-	-
Nonbinder Grade (X-group)	X1M	-	-	-	-	-	-
Nondescript Grades (N-group)	N1	N2	-	-	-	-	-
Scrap Grade (S-group)	S	-	-	-	-	-	-

*Deviations from the standard grades are sometimes authorized to show peculiar sides or characteristi not covered by the specifications for the grades. Special factors, such as U and W, are used to indic such deviations.

**Length is stated in connection with each grade of the C-group of Pennsylvania Seedleaf tobacco. For this purpose U. S. standard 2-inch sizes are used: U. S. sizes 17, 19, 21, 23, 25, 27, 29, and 31.

Product	Grade Names						
NSORTED HAVANA SEED TOBACCO (Type 52) tentative grades							
Unsorted Binder Grades (B-group)	B1M	B2M	B3M	B4M	B5M	-	-
Unsorted Nonbinder Grade (X-group)	X1M	-	-	-	-	-	-
Nondescript Grades (N-group)	N1	N2	-	-	-	-	-
Scrap Grade (S-group)	S	-	-	-	-	-	-
MERS' PACKINGS OF HAVANA SEED BACCO (Types 53, 54, and 55)* ntative grades							
nsorted Binder Packing Grades (B-group)	B1M	B2M	B3M	B4M	B5M	B6M	B7M
Binder Packing Grades (R-subgroup)	R1	R2	R3	-	-	-	-
Stripper Grades (C-group)	C1	C2	C3	-	-	-	-
Crop-run Grades (X-group)	X1	X2	X3	X4	X5	-	-
Farm-filler Grades (Y-group)	Y1	Y2	Y3	-	-	-	-
Nondescript (N-group)			(Grade is N)			-	-
ECTICUT VALLEY SHADE-GROWN ACCO (U.S. Type 61) * tative grades							
rapper Grades** (A-group)	A1L A1F -	A2L A2F -	A3L A3F -	A4L A4F A4G	A5L A5F A5G	- - -	- - -
tout Wrapper and Binder Grades** (B-group)	B1F B1R	B2F B2R	B3F B3R	- -	- -	- -	- -
ller or Tip Grades (C-group)	C1	C2	-	-	-	-	-
ller Brokes Grades (X-group)	X1	X2	-	-	-	-	-
ndescript and Scrap Grades N and S groups)			(grades are N and S)				

viations from the standard grades are sometimes authorized to show peculiar sides or characteris-
not covered by the specifications for the grades. Special factors, such as U and W, are used to
ate such deviations as limited damage and excessive moisture.
ngth may be stated in connection with the A and B groups of Connecticut Valley Shade-Grown tobacco.
nis purpose U. S. standard 1-and 2-Inch Sizes may be used. These are U. S. Sizes 8 1/2, 9 1/2,
, 11 1/2, 12 1/2, 13 1/2, 14 1/2, 15 1/2, 16 1/2, 17 1/2, 18 1/2, 19 1/2, 20 1/2, and 21 1/2, and
Sizes 9, 11, 13, 15, 17, 19, and 21.

TOBACCO

Product	Grade Names						
GEORGIA AND FLORIDA SHADE-GROWN TOBACCO (U.S. Type 62)* tentative grades							
Prime Wrapper Grades (A-group)**	A1L A1F - -	A2L A2F A2R A2G	A3L A3F A3R A3G	- - - -	- - - -	- - - -	- - - -
Injured Wrapper Grades (B-group)**	B1L B1F - -	B2L B2F B2R -	B3L B3F B3R B3G	B4L - B4R -	B5L - B5R B5G	- - - -	- - - -
Stout Wrapper and Binder Grades (C-group)	C1F C1R -	C2F C2R -	C3F C3R C3G	- - -	- - -	- - -	- - -
Filler Brokes Grades (X-group)	X1	X2	-	-	-	-	-
Nondescript and Scrap Grades (N and S groups)			(grades are N and S)				

*Deviations from the standard grades are sometimes authorized to show peculiar sides or characteristics not covered by the specifications for the grades. Special factors, such as U and W, are used to indicate such deviations as limited damage and excessive moisture.

**Length may be stated in connection with the A and B groups of Georgia and Florida Shade-grown tobacco For this purpose U. S. standard 1-, 2-, and 3-inch sizes may be used. Those applicable are U. S. sizes 10 1/2, 11 1/2, 12 1/2, 13 1/2, 14 1/2, 15 1/2, 16 1/2, 17 1/2, 18 1/2, 19 1/2, 20 1/2, and 21 1/2; U. S. sizes 11, 13, 15, 17, 19, and 21; and U. S. sizes 33, 34, 35, 36, and 37.

Naval Stores

Product	Grade Names												
ROSIN (gum, wood, and tall oil)	X	WW	WG	N	M	K	I	H	G	F	E	D	B
		(Special designation: OP; special grade for wood rosin: FF)											
TURPENTINE (Gum Spirits of Turpentine, Steam Distilled Wood Turpentine, Sulfate Wood Turpentine, and Destructively Distilled Wood Turpentine)	Water-white	Standard											

COMMODITY STABILIZATION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

COMPILATION

OF

STATUTES RELATING

TO

oil Conservation, Marketing Quotas and Allotments, Soil Bank, ommodity Credit Corporation, Price Support, Export and urplus Removal, Crop Insurance, Sugar Payments and Quotas, larketing Agreements and Orders, and Related Statutes

AS OF JANUARY 1, 1959

COMPILED UNDER THE DIRECTION
OF THE GENERAL COUNSEL

AGRICULTURE HANDBOOK NO. 158

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UNITED STATES DEPARTMENT OF AGRICULTURE

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Prefatory Note

This is a compilation of the provisions of legislation administered by the Commodity Stabilization Service and related legislation. Certain provisions of law which were applicable to prior years or crops, but which have not been repealed by the Congress, have been omitted from this compilation. Citations to the United States Code at the end of sections and subsections are to the 1952 edition of the Code and Supplement thereto.

The statutes contained in this compilation are subject to the provisions of Reorganization Plan No. 2 of 1953 (18 F. R. 3219, 67 Stat. 633, 5 U. S. C. 133z–15, note), prepared by the President and transmitted to the Senate and House of Representatives on March 25, 1953, pursuant to the provisions of the Reorganization Act of 1949 (5 U. S. C. 133z to 133z–15). The plan transfers to the Secretary of Agriculture all functions not then vested in him of all other officers and of all agencies and employees of the Department of Agriculture, except functions vested by the Administrative Procedure Act in hearing examiners employed by the Department and functions of the corporations of the Department, the Boards of Directors and officers of such corporations, the Advisory Board of the Commodity Credit Corporation, and the Farm Credit Administration.

NOTE.—This Handbook is a revision of and supersedes Agriculture Handbook No. 113, dated January 1, 1957.

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SOIL CONSERVATION AND DOMESTIC ALLOTMENT ACT, AS AMENDED

EXPLANATORY NOTE

Sections 1 to 6, which were enacted April 27, 1935 (49 Stat. 163), vested certain powers in the Secretary of Agriculture with respect to the control and prevention of soil erosion and provided for the Soil Conservation Service to be established as the agency to exercise such powers.

Sections 7 to 17 were enacted February 29, 1936 (49 Stat. 1148), to replace, in part, certain provisions of the Agricultural Adjustment Act (of 1933) which were invalidated by the Supreme Court on January 6, 1936. Section 17 provides that the entire Act may be cited as the "Soil Conservation and Domestic Allotment Act." Under the agricultural conservation program formulated pursuant to sections 7 to 17 of the Act, farmers are assisted through payments and grants of aid in carrying out approved soil and water conservation measures. Section 16 (b) was enacted August 7, 1956 (70 Stat. 1115), to provide specifically for a conservation program in the States of the Great Plains. The authority of the Secretary to carry out the program on a national basis was originally limited by section 7 (a) to a period of 2 years, during which time it was expected that a majority of the States would enact legislation relating to State plans as provided for in section 7 of the Act. About half of the States have enacted the necessary legislation, and the Congress has extended from time to time the Secretary's authority to administer the program on a national basis. Under the amendment included in this compilation, the Secretary's authority expires December 31, 1962.

PART I

SOIL CONSERVATION AND DOMESTIC ALLOTMENT ACT,[1] AS AMENDED

AN ACT

To provide for the protection of land resources against soil erosion, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it is hereby recognized that the wastage of soil and moisture resources on farm, grazing, and forest lands of the Nation, resulting from soil erosion, is a menace to the national welfare and that it is hereby declared to be the policy of Congress to provide permanently for the control and prevention of soil erosion and thereby to preserve natural resources, control floods, prevent impairment of reservoirs, and maintain the navigability of rivers and harbors, protect public health, public lands and relieve unemployment, and the Secretary of Agriculture, from now on, shall coordinate and direct all activities with relation to soil erosion and in order to effectuate this policy is hereby authorized, from time to time—

(1) To conduct surveys, investigations, and research relating to the character of soil erosion and the preventive measures needed, to publish the results of any such surveys, investigations, or research, to disseminate information concerning such methods, and to conduct demonstrational projects in areas subject to erosion by wind or water;

(2) To carry out preventive measures, including, but not limited to, engineering operations, methods of cultivation, the growing of vegetation, and changes in use of land;

(3) To cooperate or enter into agreements with, or to furnish financial or other aid to, any agency, governmental or otherwise, or any person, subject to such conditions as he may deem necessary, for the purposes of this Act; and

(4) To acquire lands, or rights or interests therein, by purchase, gift, condemnation, or otherwise, whenever necessary for the purposes of this Act. (16 U. S. C. 590a.)

LANDS ON WHICH PREVENTIVE MEASURES MAY BE TAKEN

SEC. 2. The acts authorized in section 1 (1) and (2) may be performed—

(a) On lands owned or controlled by the United States or any of its agencies, with the cooperation of the agency having jurisdiction thereof; and

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[1] Approved April 27, 1935, 49 Stat. 163.

(b) On any other lands, upon obtaining proper consent or the necessary rights or interests in such lands. (16 U. S. C. 590b.)

BENEFITS FOR NON-GOVERNMENT CONTROLLED LANDS

SEC. 3. As a condition to the extending any benefits under this Act to any lands not owned or controlled by the United States or any of its agencies, the Secretary of Agriculture may, insofar as he may deem necessary for the purposes of this Act, require—

(1) The enactment and reasonable safeguards for the enforcement of State and local laws imposing suitable permanent restrictions on the use of such lands and otherwise providing for the prevention of soil erosion;

(2) Agreements or covenants as to the permanent use of such lands; and

(3) Contributions in money, services, materials, or otherwise, to any operations conferring such benefits. (16 U. S. C. 590c.)

PERSONNEL

SEC. 4. For the purposes of this Act, the Secretary of Agriculture may—

(1) Secure the cooperation of any governmental agency;

(2) Subject to the provisions of the civil-service laws and the [Classification Act of 1949], appoint and fix the compensation of such officers and employees as he may deem necessary, except for a period not to exceed eight months from the date of this enactment, the Secretary of Agriculture may make appointments and may continue employees of the organization heretofore established for the purpose of administering those provisions of the National Industrial Recovery Act which relate to the prevention of soil erosion, without regard to the civil-service laws or regulations and the Classification Act, as amended; and any person with technical or practical knowledge may be employed and compensated under this Act on a basis to be determined by the Civil Service Commission; and

(3) Make expenditures for personal services and rent in the District of Columbia and elsewhere, for the purchase of lawbooks and books of reference, for printing and binding, for the purchase, operation, and maintenance of passenger-carrying vehicles, and perform such acts, and prescribe such regulations, as he may deem proper to carry out the provisions of this Act. (16 U. S. C. 590d.)

ESTABLISHMENT OF SOIL CONSERVATION SERVICE

SEC. 5. The Secretary of Agriculture shall establish an agency to be known as the "Soil Conservation Service,"[2] to exercise the powers conferred on him by this Act and may utilize the organization heretofore established for the purpose of administering those provisions of sections 202 and 203 of the National Industrial Recovery Act which

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[2] Functions of Soil Conservation Service in Department of Agriculture with respect to soil and moisture conservation operations conducted on lands under jurisdiction of Department of the Interior were transferred to the Department of the Interior, to be administered by the Secretary of the Interior through such agencies in the Department of the Interior as the Secretary shall designate, by Reorganization Plan No. IV, Sec. 6, effective June 30, 1940, 5 F. R. 2421, 54 Stat. 1235, 5 U. S. C. 133t note.

relate to the prevention of soil erosion, together with such personnel thereof as the Secretary of Agriculture may determine, and all unexpended balances of funds heretofore allotted to said organization shall be available until June 30, 1937, and the Secretary of Agriculture shall assume all obligations incurred by said organization prior to transfer to the Department of Agriculture. In order that there may be proper coordination of erosion-control activities the Secretary of Agriculture may transfer to the agency created under this Act such functions, funds, personnel, and property of other agencies in the Department of Agriculture as he may from time to time determine. (16 U. S. C. 590e.)

APPROPRIATION AUTHORIZED

SEC. 6. There are hereby authorized to be appropriated for the purposes of this Act such sums as Congress may from time to time determine to be necessary. Appropriations for carrying out this Act allocated for the production or procurement of nursery stock by any Federal agency, or funds appropriated to any Federal agency for allocation to cooperating States for the production or procurement of nursery stock, shall remain available for expenditure for not more than 3 fiscal years. (16 U. S. C. 590f.)

[Department of Agriculture Organic Act of 1944. SEC. 302. (b) The Soil Conservation Service may sell and distribute supplies, materials, and equipment to other Government activities, the cost of such supplies and materials or the value of such equipment (including the cost of transportation and handling) to be reimbursed to appropriations current at the time additional supplies, materials, or equipment are procured from the appropriations chargeable with the cost or value of such supplies, materials, or equipment. (16 U. S. C. 590q-1.)]

AGRICULTURAL CONSERVATION POLICY AND ENUMERATION OF PURPOSES

SEC. 7. (a) It is hereby declared to be the policy of this Act also to secure, and the purposes of this Act shall also include, (1) preservation and improvement of soil fertility; (2) promotion of the economic use and conservation of land; (3) diminution of exploitation and wasteful and unscientific use of national soil resources; (4) the protection of rivers and harbors against the results of soil erosion in aid of maintaining the navigability of waters and water courses and in aid of flood control; and (5) reestablishment, at as rapid a rate as the Secretary of Agriculture determines to be practicable and in the general public interest, of the ratio between the purchasing power of the net income per person on farms and that of the income per person not on farms that prevailed during the five-year period August 1909–July 1914, inclusive, as determined from statistics available in the United States Department of Agriculture, and the maintenance of such ratio. The powers conferred under sections 7 to 14, inclusive, of this Act shall be used to assist voluntary action calculated to effectuate the purposes specified in this section. Such powers shall not be used to discourage the production of supplies of foods and fibers sufficient to maintain normal domestic human consumption as determined by the Secretary from the records of domestic human consumption in the

years 1920 to 1929, inclusive, taking into consideration increased population, quantities of any commodity that were forced into domestic consumption by decline in exports during such period, current trends in domestic consumption and exports of particular commodities, and the quantities of substitutes available for domestic consumption within any general class of food commodities. In carrying out the purposes of this section due regard shall be given to the maintenance of a continuous and stable supply of agricultural commodities adequate to meet consumer demand at prices fair to both producers and consumers. (16 U. S. C. 590g (a).)

GRANTS TO STATES

(b) The Secretary of Agriculture shall cooperate with States, in the execution of State plans to effectuate the purposes of this section, by making grants under this section to enable them to carry out such plans. (16 U. S. C. 590g (b).)

SUBMISSION OF STATE PLANS

(c) Any State which submits to the Secretary, prior to such time and in such manner and form as the Secretary prescribes, a State plan to effectuate the purposes of this section shall be entitled to payments, as provided in this section, for the year to which such plan is applicable, if such plan is approved by the Secretary as provided in this section. (16 U. S. C. 590g (c).)

REQUIREMENTS OF STATE PLANS

(d) No such plan shall be approved unless by its terms:

(1) It provides that the agency to administer the plan shall be such State agency as may be designated by the Secretary if such agency is authorized by the State, or such other State agency as is authorized by the State and approved by the Secretary;

(2) It provides for such methods of administration, and such participation in the administration of the plan by county and community committees or associations of agricultural producers organized for such purpose, as the Secretary finds necessary for the effective administration of the plan; and

(3) It provides for the submission to the Secretary of such reports as he finds necessary to ascertain whether the plan is being carried out according to its terms, and for compliance with such requirements as the Secretary may prescribe to assure the correctness of and make possible the verification of such reports. (16 U. S. C. 590g (d).)

APPROVAL OF STATE PLANS

(e) Such plan shall be approved if the Secretary finds that there is a reasonable prospect that—

(1) Substantial accomplishment in effectuating the purposes of this section will be brought about through the operation of such plan and the plans submitted by other States, and

(2) The operation of such plan will result in as substantial a furtherance of such accomplishment as may reasonably be achieved through the action of such State. (16 U. S. C. 590g (e).)

ALLOCATION OF FUNDS FOR STATE PLANS

(f) Upon approval of any State plan for any year the Secretary shall allocate to such State such sum (not in excess of the maximum amount fixed in pursuance of subsection (g) for such State for such year) as he finds necessary to carry out such plan for such year, and thereupon shall certify to the Secretary of the Treasury for payment to such agency of the State as the Secretary of Agriculture certifies is designated in the plan, and the Secretary of the Treasury shall pay to such agency, one-fourth of the amount so allocated. The remainder of the amount so allocated shall be similarly certified and paid in such installments (payable prior to the end of the calendar year) as may be provided in the plan. No such installment shall be certified for payment if the Secretary of Agriculture finds that, prior to the due date of such installment, there has been a substantial failure by the State to carry out the plan according to its terms, or that the further operation of the plan according to its terms will not tend to effectuate the purposes of this section. No amount shall be certified for payment under any such installment in excess of the amount the Secretary finds necessary for the effective carrying out of the plan during the period to which the installment relates. (16 U. S. C. 590g (f).)

APPORTIONMENT OF FUNDS FOR SUCCEEDING YEAR STATE PLANS

(g) On or before November 1 of each year, the Secretary shall apportion among the several States the funds which will be available for carrying out State plans during the next calendar year, and in determining the amount to be apportioned to each State, the Secretary shall take into consideration the acreage and value of the major soil depleting and major export crops produced in the respective States during a representative period and the acreage and productivity of land devoted to agricultural production (including dairy products) in the respective States during a representative period: *Provided, however*, That any such apportionment of funds available for carrying out State plans during any year prior to 1942 may be made at any time prior to or during the year to which such plans relate. Notwithstanding the making of an apportionment to any State for any calendar year, the funds apportioned to any State for which no plan has been approved for such year, and any amount apportioned to any State which is not required to carry out an approved plan for such State for such year, shall be available for carrying out the provisions of sections 7to 14, inclusive, of this Act. (16 U. S. C. 590g (g).)

AUTHORITY OF SECRETARY TO MAKE PAYMENTS OR GRANTS OF AID DIRECTLY TO FARMERS

SEC. 8. (a) In order to carry out the purposes specified in section 7 (a) during the period necessary to afford a reasonable opportunity for legislative action by a sufficient number of States to assure the

effectuation of such purposes by State action and in order to promote the more effective accomplishment of such purposes by State action thereafter, the Secretary shall exercise the powers conferred in this section during the period prior to January 1, 1963, except with respect to farming operations commenced in any State after the effective date of a State plan for such State approved pursuant to section 7. No such powers shall be exercised after December 31, 1962, except with respect to payments or grants in connection with farming operations carried out prior to January 1, 1963. During the period prior to January 1, 1963, the Secretary shall carry out the purposes specified in section 7 (a) through State action as rapidly as adequate State laws are enacted and satisfactory State plans are submitted. Notwithstanding the foregoing provisions of this section and section 7, the provisions of this section with respect to the State, county, and local committees of farmers shall continue in full force and effect for purposes other than the administration of State plans. (16 U. S. C. 590h (a).)[3]

BASIS FOR PAYMENTS AND GRANTS OF AID; LOCAL, COUNTY, AND STATE COMMITTEES; CONSERVATION MATERIALS AND SERVICES

(b) Subject to the limitations provided in subsection (a) of this section, the Secretary shall have power to carry out the purposes specified in clauses (1), (2), (3), (4), and (5) of section 7 (a) by making payments or grants of other aid to agricultural producers, including tenants and sharecroppers, in amounts determined by the Secretary to be fair and reasonable in connection with the effectuation of such purposes during the year with respect to which such payments or grants are made, and measured by (1) their treatment or use of their land, or a part thereof, for soil restoration, soil conservation, or the prevention of erosion; (2) changes in the use of their land; (3) their equitable share, as determined by the Secretary, of the normal national production of any commodity or commodities required for domestic consumption; or (4) their equitable share, as determined by the Secretary, of the national production of any commodity or commodities required for domestic consumption and exports adjusted to reflect the extent to which their utilization of cropland on the farm conforms to farming practices which the Secretary determines will best effectuate the purposes specified in section 7 (a); or (5) any combination of the above. Clauses (1) and (2) above shall be construed to cover water conservation and the beneficial use of water on individual farms, including measures to prevent runoff, the building of check dams and ponds, and providing facilities for applying water to the land. In determining the amount of any payment or grant measured by (1) or (2) the Secretary shall take into consideration the productivity of the land affected by the farming practices adopted during the year with respect to which such payment is made. In carrying out the provisions of this section in the continental United States, the Secretary is directed to utilize the services of local and State committees selected as hereinafter provided. The Secretary shall designate local administrative areas as units for administration of programs under this sec-

[3] The Secretary's authority to administer the program on a national basis was extended until December 31, 1962, by the Act of July 25, 1958, Pub. L. 85–553, 72 Stat. 414.

tion. No such local area shall include more than one county or parts of different counties. Farmers within any such local administrative area, and participating or cooperating in programs administered within such area, shall elect annually from among their number a local committee of not more than three members for such area and shall also elect annually from among their number a delegate to a county convention for the election of a county committee. The delegates from the various local areas in the county shall, in a county convention, elect, annually, the county committee for the county which shall consist of three members who are farmers in the county. The local committee shall select a secretary and may utilize the county agricultural extension agent for such purpose. The county committee shall select a secretary who may be the county agricultural extension agent. If such county agricultural extension agent shall not have been elected secretary of such committee, he shall be ex officio a member of the county committee. The county agricultural extension agent shall not have the power to vote. In any county in which there is only one local committee the local committee shall also be the county committee. In each State there shall be a State committee for the State composed of not less than three or more than five farmers who are legal residents of the State and who are appointed by the Secretary. The State director of the Agricultural Extension Service shall be ex officio a member of such State committee. The ex officio members of the county and State committees shall be in addition to the number of members of such committees hereinbefore specified. The Secretary shall make such regulations as are necessary relating to the selection and exercise of the functions of the respective committees, and to the administration, through such committees, of such programs. In carrying out the provisions of this section, the Secretary—shall, as far as practicable, protect the interests of tenants and sharecroppers; is authorized to utilize the agricultural extension service and other approved agencies; shall accord such recognition and encouragement to producer-owned and producer-controlled cooperative associations as will be in harmony with the policy toward cooperative associations set forth in existing Acts of Congress and as will tend to promote efficient methods of marketing and distribution; shall not have power to acquire any land or any right or interest therein; shall, in every practicable manner, protect the interests of small producers; and shall in every practical way encourage and provide for soil-conserving and soil-rebuilding practices rather than the growing of soil-depleting crops. Rules and regulations governing payments or grants under this subsection shall be as simple and direct as possible, and, wherever practicable, they shall be classified on two bases: (a) Soil-depleting crops and practices, (b) soil-building crops and practices.

Notwithstanding any other provision of law, in making available conservation materials consisting of seeds, seed inoculants, fertilizers, liming and other soil-conditioning materials, trees, or plants, or in making available soil-conserving or soil-building services, to agricultural producers under this subsection, the Secretary may make payments, in advance of determination of performance by the producers, to persons who fill purchase orders covering approved conservation materials or covering soil-conserving or soil-building services, furnished to producers, or who render services to the Secretary in deliver-

ing to producers approved conservation materials, for the carrying out, by the producers, of soil-building or soil-conserving practices approved by the Secretary. The price at which purchase orders for any conservation materials or services are filled may be limited to a fair price fixed in accordance with regulations prescribed by the Secretary.

Appropriations are hereby authorized for the purchase in advance of the program year for which the appropriation is made of seeds, fertilizers, lime, trees, or any other farming materials or any soil-terracing services, and making grants thereof to agricultural producers to aid them in carrying out farming practices approved by the Secretary in programs under this Act; for the reimbursement of any Federal, State, or local government agency for fertilizers, seeds, lime, trees, or other farming materials, or any soil-terracing services, furnished by such agency; and for the payment of all expenses necessary in making such grants, including all or part of the costs incident to the delivery thereof. (16 U. S. C. 590h (b).)

[Agricultural Act of 1954. SEC. 503. Nothing contained in section 8 (b) of the Soil Conservation and Domestic Allotment Act, as amended, or in any other provision of law, shall be construed to authorize the Secretary of Agriculture to impose any limitations upon the number of terms for which members of county committees established under such section may be reelected. (16 U. S. C. 590h-3.)]

[Department of Agriculture Organic Act of 1956. SEC. 6 (b) Payments of grants under sections 7 to 17 of the Soil Conservation and Domestic Allotment Act, as amended, may be conditioned upon the utilization of land with respect to which such payments or grants are to be made in conformity with farming practices which will encourage and provide for soil-building and soil- and water-conserving practices in the most practical and effective manner and adapted to conditions in the several States, as determined and approved by the State committees appointed pursuant to section 8 (b) of such Act, for the respective States. (16 U. S. C. 590h-4.)]

[PUBLIC LAW 85–278—*That, notwithstanding the provisions of subsection (b) of section 8 of the Soil Conservation and Domestic Allotment Act, two county committees shall be elected annually under such subsection for the counties of Otter Tail, Polk, and Saint Louis, in the State of Minnesota, and for the county of Pottawattamie, in the State of Iowa, and that the actions heretofore or hereafter taken by each of such committees shall be given the same effect in the area served by it as is given to the actions of the county committee in a county served by a single county committee.*][4]

APPORTIONMENT OF ACREAGE ALLOTMENTS [5]

(c) (1) In apportioning acreage allotments under this section in the case of wheat and corn, the national and State allotments and the allotments to counties shall be apportioned annually on the basis of the acreage seeded for the production of the commodity during the ten calendar years immediately preceding the calendar year in which

[4] Material in italics added by Pub. L. 85–278, 71 Stat. 601, September 2, 1957, 16 U. S. C. 590h note.

[5] See page 49 for the Act of February 28, 1945, which provides for the effect of production of war crops, or military service, on allotments.

the national acreage allotment is determined (plus, in applicable years, the acreage diverted under previous agricultural adjustment and conservation programs), with adjustments for abnormal weather conditions and trends in acreage during the applicable period.

(2) In the case of wheat, the allotment to any county shall be apportioned annually by the Secretary, through the local committees, among the farms within such county on the basis of tillable acres, crop-rotation practices, type of soil, and topography. Not more than 3 per centum of such county allotment shall be apportioned to farms on which wheat has not been planted during any of the three marketing years immediately preceding the marketing year in which the allotment is made. Notwithstanding any other provision of this section, the allotments established, or which would have been established, for any farm acquired in 1940 or thereafter by the United States for national-defense purposes shall be placed in an allotment pool and shall be used only to establish allotments for other farms owned or acquired by the owner of the farm so acquired by the United States. The allotments so made for any farm, including a farm on which wheat has not been planted during any of the three marketing years preceding the marketing year in which the allotment is made shall compare with the allotments established for other farms in the same area which are similar except for the past acreage of wheat. (16 U. S. C. 590h (c).)

(3) In the case of corn, the allotment to any county shall be apportioned annually by the Secretary, through the local committees, among the farms within such county on the basis of tillable acreage, type of soil, topography, and crop-rotation practices.

(4) (Repealed by 53 Stat. 573, April 10, 1939.)

(5) In determining normal yield per acre for any county under this section in the case of wheat or corn, the normal yield shall be the average yield per acre therein for such commodity during the ten calendar years immediately preceding the calendar year in which such yield is determined, adjusted for abnormal weather conditions and trends in yields. If for any reason, there is no actual yield, or the data therefor are not available for any year, then an appraised yield for such year, determined in accordance with regulations of the Secretary, shall be used. If, on account of drought, flood, insect pests, plant disease, or other uncontrollable natural cause, the yield in any year of such ten-year period is less than 75 per centum of the average (computed without regard to such year), such year shall be eliminated in calculating the normal yield per acre. Such normal yield per acre for any county need be redetermined only when the actual average yield for the ten calendar years immediately preceding the calendar year in which such yield is being reconsidered differs by at least 5 per centum from the actual average yield for the ten years upon which the existing normal yield per acre for the county was based.

(6) In determining normal yield per acre for any farm under this section in the case of wheat or corn, the normal yield shall be the average yield per acre thereon for such commodity during the ten calendar years immediately preceding the calendar year in which such yield is determined, adjusted for abnormal weather conditions and trends in yields. If for any such year the data are not available,

or there is no actual yield, then the normal yield for the farm shall be appraised in accordance with regulations of the Secretary, taking into consideration abnormal weather conditions, the normal yield for the county, and the yield in years for which data are available. (16 U. S. C. 590h (c).)

CONDITIONS AFFECTING PAYMENTS OR GRANTS OF AID

(d) Any payment or grant of aid made under subsection (b) shall be conditioned upon the utilization of the land, with respect to which such payment is made, in conformity with farming practices which the Secretary finds tend to effectuate any one or more of the purposes specified in clause (1), (2), (3), (4), or (5) of section 7 (a).

Any payment made under subsection (b) with respect to any farm (except for lands which the Secretary determines should not be utilized for the harvesting of crops but should be permanently used for grazing purposes only) shall, if the number of cows kept on such farm, and in the county in which such farm is located, for the production of milk or products thereof (for market), exceeds the normal number of such cows, be further conditioned upon the utilization of the land, with respect to which such payment is made, so that soil-building and soil-conserving crops planted or produced on an acreage equal to the land normally used for the production of soil-depleting crops, but, as a condition of such payment, not permitted to be so used, shall be used for the purpose of building and conserving the fertility of the soil, or for the production of agricultural commodities to be consumed on the farm, and not for market. Whenever it is determined that a county, as a whole, is in substantial compliance with the provisions of this paragraph, no payment shall be denied any individual farmer in the county by reason of this paragraph; and no payment shall be denied a farmer by reason of this paragraph unless it has been determined that the farmer has not substantially complied with the provisions of this paragraph. Whenever the Secretary finds that by reason of drought, flood, or other disaster, a shortage of feed exists in any area, he shall so declare, and to the extent and for the period he finds necessary to relieve such shortage, the operation of the condition provided in this paragraph shall be suspended in such area and, if necessary to relieve such shortage, in other areas defined by him. As used in this paragraph, the term "for market" means for disposition by sale, barter, or exchange, or by feeding (in any form) to dairy livestock which, or the products of which, are to be sold, bartered or exchanged; and such term shall not include consumption on the farm. An agricultural commodity shall be deemed consumed on the farm if consumed by the farmer's family, employees, or household, or if fed to poultry or livestock other than dairy livestock on his farm; or if fed to dairy livestock on his farm and such dairy livestock, or the products thereof, are to be consumed by his family, employees, or household. Whenever the Secretary has reason to believe the income of producers of livestock (other than dairy cattle) or poultry in any area from such sources is being adversely affected by increases in the supply for market of such livestock or poultry, as the case may be, arising as a result of programs carried out under this Act, he shall make an investigation with respect to the existence of such facts.

If, upon investigation, the Secretary finds that the income of producers of such livestock, or poultry, as the case may be, in any area from any such source is being adversely affected by such increases, he shall, as soon as practicable, make such provision in the administration of this Act with respect to the use of diverted acres as he may find necessary to protect the interests of producers of such livestock or poultry in the affected area. (16 U. S. C. 590h (d).)

DIVISION OF PAYMENTS AMONG LANDLORDS, TENANTS, AND SHARECROPPERS

(e) Payments made by the Secretary to farmers under subsection (b) shall be divided among the landlords, tenants, and sharecroppers of any farm, with respect to which such payments are made, in the same proportion that such landlords, tenants, and sharecroppers are entitled to share in the proceeds of the agricultural commodity with respect to which such payments are made, or, effective with respect to the 1942 and subsequent farm programs, in the event of acquisition of title to, or lease of, any farm for use in connection with the national war effort which caused the producers on such farms to lose, prior to the time of harvest, their interests in the crops planted thereon, or the proceeds thereof, payments with respect to such crops, to the extent that full compensation for the loss of payments with respect thereto in connection with such acquisition or lease was not made to such producers, shall be divided among the landlords, tenants, and sharecroppers on such farm in the proportion which it is determined that such producers would have been entitled to share in the proceeds of such crops but for such acquisition or lease: *Provided*, That payments based on soil-building or soil-conserving practices shall be divided in proportion to the extent which such landlords, tenants, and sharecroppers contribute to the carrying out of such practices. Such payments shall be paid by the Secretary directly to the landlords, tenants, or sharecroppers entitled thereto, and shall be computed at rates which will permit the Secretary to set aside out of the funds available for the making of such payments for each year an amount sufficient to permit the increases herein specified to be made within the limits of the funds so available. If with respect to any farm the total payment to any person for any year would be:

(1) Not more than $20, the payment shall be increased by 40 per centum;

(2) More than $20 but not more than $40, the payment shall be increased by $8, plus 20 per centum of the excess over $20;

(3) More than $40 but not more than $60, the payment shall be increased by $12, plus 10 per centum of the excess over $40;

(4) More than $60 but not more than $186, the payment shall be increased by $14; or

(5) More than $186 but less than $200, the payment shall be increased to $200.

In the case of payments of more than $1, the amount of the payment which shall be used to calculate the 40-, 20-, and 10-per-centum increases under clauses (1), (2), and (3) shall not include that part, if any, of the payment which is a fraction of a dollar.

Beginning with the calendar year 1939, no total payment for any year to any person under such subsection (b) shall exceed $10,000.

In the case of payments made to any individual, partnership, or estate on account of performance on farms in different States, Territories, or possessions, the $10,000 limitation shall apply to the total of the payments for each State, Territory, or possession, for a year and not to the total of all such payments.

Persons who carry out farming operations as tenants or sharecroppers on cropland owned by the United States Government and who comply with the terms and conditions of the conservation program, formulated pursuant to sections 7 to 17, inclusive, of this Act, as amended, shall be entitled to apply for and receive payments, or to retain payments heretofore made, for their participation in said program to the same extent as other producers. Persons who carry out conservation practices on federally owned noncropland which directly conserve or benefit nearby or adjoining privately owned lands of such persons and who maintain and use such Federal land under agreement with the Federal agency having jurisdiction thereof and who comply with the terms and conditions of the agricultural conservation program formulated pursuant to sections 7 to 17 of this Act, as amended, shall be entitled to apply for and receive payments under such program to the same extent as other producers. (16 U. S. C. 590h (e).)

CHANGE BETWEEN LANDLORD AND TENANTS OR SHARECROPPERS AFFECTING LANDLORD'S PAYMENTS

(f) Any change in the relationship between the landlord and the tenants or sharecroppers, with respect to any farm, that would increase over the previous year the amount of payments or grants of other aid under subsection (b) that would otherwise be made to any landlord shall not operate to increase such payment or grant to such landlord. Any reduction in the number of tenants below the average number of tenants on any farm during the preceding three years that would increase the payments or grants of other aid under such subsection that would otherwise be made to the landlord shall not hereafter operate to increase any such payment or grant to such landlord. Such limitations shall not apply if on investigation the local committee finds that the change is justified and approves such change in relationship or reduction. Such action of local committees shall be subject to approval or disapproval by State committees. (16 U. S. C. 590h (f).)

ASSIGNMENT OF PAYMENT

(g) A payment which may be made to a farmer under this section, may be assigned, without discount, by him in writing as security for cash or advances to finance making a crop. Such assignment shall be signed by the farmer and witnessed by a member of the county or other local committee, or by the treasurer or the secretary of such committee, and filed with the county agent or the county committee. Such assignment shall include the statement that the assignment is not made to pay or secure any preexisting indebtedness. This provision shall not authorize any suit against or impose any liability upon the Secretary or any disbursing agent if payment to the farmer is made without regard to the existence of any such assignment. (16 U. S. C. 590h (g).)

[NAVAL STORES CONSERVATION PROGRAM.—In administering the naval stores conservation programs authorized in section 8 and in making payments thereunder to gum naval stores producers the Secretary may utilize the services of regional associations of such producers or any agency of the Government in lieu of the State, county, and other local committees utilized in the other agricultural conservation programs if he finds more efficient administration will result, and the provisions of section 388 (b) of the Agricultural Adjustment Act of 1938 shall otherwise be applicable to the administration of said naval stores conservation programs. (16 U. S. C. 590h-1.)]

[DEFERRED GRADING PROGRAM.—PUBLIC LAW 85–25—*That notwithstanding any other provision of law, in connection with any major disaster due to drought determined by the President to warrant assistance by the Federal Government under Public Law 875, Eighty-first Congress, as amended, the President is authorized and directed as part of the assistance provided pursuant to such Act to formulate and carry out, through the facilities of the Department of Agriculture, a deferred grazing program, which shall include nonuse or limited use, or any needed combination thereof, in any county affected by such disaster in which the Secretary of Agriculture determines grazing of native rangeland is a substantial factor in agricultural production, and finds that limited or deferred grazing is necessary and appropriate for the reestablishment or conservation of grass for grazing. Such program shall be applicable only to nonfederally owned land which is normally used for grazing. Within thirty days (1) after the date of enactment of this Act, or (2) after any subsequent designation of any such area as a disaster area by the President, the Secretary shall designate the counties in any such area in which this program shall be available, and the program shall remain available in each such county for a period of not more than five years after the date of enactment of this Act.*

Sec. 2. The program shall provide for payment for deferred grazing to farmers and ranchers at rates equal to the fair rental value of the land for the grazing use withheld under the program, as determined by the Secretary on the basis of the normal grazing capacity of the land during periods of adequate precipitation. No payment shall be made under the program if it is determined that a shift of livestock from the deferred areas to other land results in overgrazing nondeferred areas. Payment to any person for deferred grazing on land in any one county or land in more than one county operated as a single unit shall not exceed $5,000 for any one year.

Sec. 3. The program authorized herein may include such terms and conditions, in addition to those specifically provided for herein, as are determined desirable to effectuate its purposes and to facilitate practical administration. The program authorized herein for any county shall be supplemental to the agricultural conservation program, and not in substitution of, other programs in such county authorized by any other law, except that no payment shall be made concurrently on the same land for deferred grazing under this and any other program.

Sec. 4. There is hereby authorized to be appropriated, in addition to other funds authorized to be appropriated for the purposes of

Public Law 875, Eighty-first Congress, such funds as are necessary to carry out the program authorized herein.[6] (42 U. S. C. 1855b note.)]

SURVEYS, INVESTIGATIONS, AND REPORTS

SEC. 9. The Secretary is authorized to conduct surveys, investigations, and research relating to the conditions and factors affecting, and methods of accomplishing most effectively, the policy and purposes of section 7 (a). Notwithstanding any provision of existing law, the Secretary is authorized to make public such information as he deems necessary to carry out the provisions of this Act. The Secretary shall transmit to the Congress a report, for the fiscal year ending June 30, 1937, and for each fiscal year thereafter, of the operations for such year under sections 7 to 14, inclusive, of this Act, which report shall include a statement of the expenditures made and obligations incurred, by classes and amounts. (16 U. S. C. 590i.)

DEFINITION OF AGRICULTURAL COMMODITY

SEC. 10. The term "agricultural commodity" as used in this Act means any such commodity and any regional or market classification, type, or grade thereof. (16 U. S. C. 590j.)

AVAILABILITY OF FUNDS

SEC. 11. All funds available for carrying out this Act shall be available for allotment to the bureaus and offices of the Department of Agriculture and for transfer to such other agencies of the Federal or State Governments, or to local public agencies, as the Secretary may request to cooperate or assist in carrying out this Act, and for payments to committees or associations of producers in any region or regions to cover the estimated administrative expenses to be incurred by any such committee or association in cooperating in carrying out this Act: *Provided*, That the Secretary may prescribe that all or part of such estimated expenses of any such committee or association may be deducted pro rata from the payments or grants made to the members thereof: *Provided further*, That the Secretary may make such payments in advance of determination of performance: *Provided further*, That the transfer of funds for services of technicians in formulating and carrying out agricultural conservation programs, from allotments for agricultural conservation payments within a State, shall be subject to such limitations and conditions as may be provided in appropriation or other law. Funds so transferred may be placed in a single account for each State. (16 U. S. C. 590k.)

EXPANSION OF MARKETS FOR AGRICULTURAL COMMODITIES AND ADVANCING FUNDS TO FEDERAL CROP INSURANCE CORPORATION

SEC. 12. (a) Whenever the Secretary finds that the exercise of the powers conferred in this section will tend to carry out the purpose specified in clause (5) of section 7 (a), or will tend to provide for and maintain a continuous and stable supply of agricultural commodities adequate to meet consumer demand at prices fair to both producers

[6] Material in italics enacted by Pub. L. 85–25, 71 Stat. 26, approved April 25, 1957.

and consumers, or both, he shall use such part as he deems necessary of the sums appropriated to carry out this Act for the expansion of domestic and foreign markets or for seeking new or additional markets for agricultural commodities or the products thereof or for the removal or disposition of surpluses of such commodities or the products thereof. (16 U. S. C. 590*l* (a).)

(b) The Secretary is authorized to make advances to producers for the purpose of assisting them to insure their crops with the Federal Crop Insurance Corporation. The Secretary shall remit the amount of any such advances to a producer directly to such Corporation in payment of the premium on the insurance for which the producer has made application. Advances shall only be made to producers who are participating or who agree to participate in a program formulated pursuant to section 8. Except as otherwise provided in this subsection, the terms and conditions of such advances shall be fixed by the Secretary. In carrying out the provisions of this subsection, the Secretary may transfer to the Federal Crop Insurance Corporation, prior to the execution of applications for insurance or requests for advances by producers, the funds estimated as necessary to cover the advances which will be requested for the payment of premiums under a crop-insurance program, and any portion of such funds not used for advances to producers under such program shall be returned to the Secretary by the Federal Crop Insurance Corporation. (16 U. S. C. 590*l* (b))

EXECUTION OF POWERS OF SECRETARY BY PRODUCTION AND MARKETING ADMINISTRATION

SEC. 13. Notwithstanding the foregoing provisions of this Act, the Secretary is authorized and directed to provide for the execution by the Production and Marketing Administration of such powers conferred upon him under sections 7 to 14, inclusive, of this Act as he deems may be appropriately exercised by such Administration, and for such purposes the provisions of law applicable to the appointment and compensation of persons employed by the Production and Marketing Administration shall apply. (16 U. S. C. 590m).

FINALITY OF DETERMINATIONS

SEC. 14. The facts constituting the bases for any payment or grant or the amount thereof authorized to be made under section 7 or 8 hereof, when officially determined in conformity with rules or regulations prescribed by the Secretary of Agriculture, shall be reviewable only by the Secretary of Agriculture. Payments to claimants under sections 7 to 17, inclusive, of this Act may be made upon the certificate of the claimant, which certificate shall be in such form as the Secretary of Agriculture may prescribe, that he has carried out the conservation practice or practices and has complied with all other requirements as conditions for such payments and that the statements and information contained in the application for payment are correct and true, to the best of his knowledge and belief, under the penalties of title 18, United States Code. (16 U. S. C. 590n).

APPROPRIATIONS AUTHORIZATIONS AND ALLOCATION OF FUNDS

SEC. 15. To enable the Secretary of Agriculture to carry out the purposes of sections 7 and 8 there is hereby authorized to be appropriated for any fiscal year not exceeding $500,000,000.

The funds available for payments (after allowing for estimated administrative expenses, and not to exceed 5 per centum for payments with respect to range lands, noncrop pasture lands, and naval stores) shall be allocated among the commodities produced with respect to which payments or grants are to be computed. In allocating funds among the commodities the Secretary shall take into consideration and give equal weight to (1) the average acreages planted to the various commodities (including rotation pasture), for the ten years 1928 to 1937, adjusted for abnormal weather and other conditions, including acreage diverted from production under the agricultural adjustment and soil conservation programs; (2) the value at parity prices of the production from the allotted acreages of the various commodities for the year with respect to which the payment is made; (3) the average acreage planted to the various commodities during the ten years 1928 to 1937, including the acreage diverted from production under the agricultural adjustment and soil conservation programs, in excess of the allotted acreage for the year with respect to which the payment is made; and (4) the value based on average prices for the preceding ten years of the production of the excess acreage determined under item (3). The rate of payment used in making payments to the producers of each commodity shall be such that the estimated payments with respect to such commodity shall equal the amount of funds allocated to such commodity as herein provided. For the purpose of allocating funds and computing payments or grants the Secretary is authorized to consider as a commodity a group of commodities or a regional or market classification of a commodity. For the purpose of computing payments or grants, the Secretary is authorized to use funds allocated to two or more commodities produced on farms of a designated regional or other classification to compute payments with respect to one of such commodities on such farms, and to use funds, in an amount equal to the estimated payments which would be made in any county, for making payments pursuant to a special program under section 8 aproved by the Secretary for such county: *Provided*, That farm acreage allotments shall be made for wheat in 1938, but in determining compliance wheat shall be considered in the group with other crops for which special acreage allotments are not made. Notwithstanding the foregoing provisions of this section and the provisions of section 7 (g), programs of soil building practices and soil- and water-conserving practices shall be based on a distribution of the funds available for payments and grants among the several States in accordance with their conservation needs, as determined by the Secretary, except that the proportion allocated to any State shall not be reduced by more than 15 per centum from the distribution of such funds for the next preceding program year. In carrying out such programs, the Secretary shall give particular consideration to conservation problems on farm lands diverted from crops under acreage allotment programs and to the maitenance of a proper balance between soil conserving and soil depleting crops on the farm. (16 U. S. C. 590o).)

LIMITATION ON OBLIGATIONS INCURRED

SEC. 16. (a) The obligations incurred for the purpose of carrying out for any calendar year, the provisions of sections 7 to 14, inclusive, of this Act shall not exceed $500,000,000. (16 U. S. C. 590p (a)).

GREAT PLAINS CONSERVATION PROGRAM

(b) Notwithstandig any other provision of law—

(1) the Secretary is authorized, within the amounts of such appropriations as may be provided therefor, to enter into contracts of not to exceed ten years with producers in the Great Plains area determined by him to have control for the contract period of the farms or ranches covered thereby. Such contracts shall be designed to assist farm and ranch operators to make, in orderly progression over a period of years, changes in their cropping systems and land uses which are needed to conserve the soil and water resources of their farms and ranches and to install the soil and water conservation measures needed under such changed systems and uses. Such contracts shall be in effect during the period ending not later than December 31, 1971, on farms and ranches in counties in the Great Plains area of the States of Colorado, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming, designated by the Secretary as susceptible to serious wind erosion by reason of their soil types, terrain, and climatic and other factors. The producer shall furnish to the Secretary a plan of farming operations which incorporates such soil and water conservation practices and principles as may be determined by him to be practicable for maximum mitigation of climatic hazards of the area in which the farm is located, and which outlines a schedule of proposed changes in cropping systems and land use and of the conservation measures which are to be carried out on the farm or ranch during the contract period to protect the farm or ranch from erosion and deterioration by natural causes. Under the contract the producer shall agree—

(i) to effectuate the plan for his farm or ranch substantially in accordance with the schedule outlined therein unless any requirement thereof is waived or modified by the Secretary pursuant to paragraph (3)of this subsection;

(ii) to forfeit all rights to further payments or grants under the contract and refund to the United States all payments or grants received thereunder upon his violation of the contract at any stage during the time he has control of the farm if the Secretary determines that such violation is of such a nature as to warrant termination of the contract, or to make refunds or accept such payment adjustments as the Secretary may deem appropriate if he determines that the producer's violation does not warrant termination of the contract;

(iii) upon transfer of his right and interest in the farm or ranch during the contract period to forfeit all rights to further payments or grants under the contract and refund

to the United States all payments or grants received thereunder unless the transferee of the farm or ranch agrees with the Secretary to assume all obligations of the contract;

(iv) not to adopt any practice specified by the Secretary in the contract as a practice which would tend to defeat the purposes of the contract;

(v) to such additional provisions as the Secretary determines are desirable and includes in the contract to effectuate the purposes of the program or to facilitate the practical administration of the program.

In return for such agreement by the producer the Secretary shall agree to share the cost of carrying out those conservation practices set forth in the contract for which he determines that cost-sharing is appropriate and in the public interest. The portion of such cost (including labor) to be shared shall be that part which the Secretary determines is necessary and appropriate to effectuate the physical installation of the conservation measures under the contract;

(2) the Secretary may terminate any contract with a producer by mutual agreement with the producer if the Secretary determines that such termination would be in the public interest, and may agree to such modification of contracts previously entered into as he may determine to be desirable to carry out the purposes of the program or facilitate the practical administration thereof;

(3) insofar as the acreage of cropland on any farm enter into the determination of acreage allotments and marketing quotas under the Agricultural Adjustment Act of 1938, as amended, the cropland acreage on the farm shall not be decreased during the period of any contract entered into under this subsection by reason of any action taken for the purpose of carrying out such contract;

(4) the acreage on any farm which is determined under regulations of the Secretary to have been diverted from the production of any commodity subject to acreage allotments or marketing quotas in order to carry out the contract entered into under the program shall be considered acreage devoted to the commodity for the purposes of establishing future State, county, and farm acreage allotments under the Agricultural Adjustment Act of 1938, as amended;

(5) in applying the provisions of paragraph (6) of Public Law 74, Seventy-seventh Congress (7 U. S. C. 1340 (6)), relating to the reduction of storage amount of wheat, any acreage diverted from the production of wheat under the program carried out under this subsection shall be regarded as wheat acreage;

(6) the Secretary shall utilize the technical services of agencies of the Department of Agriculture in determining the scope and provisions of any plan and the acceptability of the plan for effectuating the purposes of the program. In addition the Secretary shall take into consideration programs of State and local agencies, including soil conservation districts, having for their purposes the objectives of maximum soil and water conservation;

(7) there is hereby authorized to be appropriated without fiscal year limitations, such sums as may be necessary to carry

out this subsection: *Provided*, That the total cost of the program (excluding administrative costs) shall not exceed $150,000,000, and for any program year payments shall not exceed $25,000,000. The funds made available for the program under this subsection may be expended without regard to the maximum payment limitation and small payment increases required under section 8 (e) of this Act, and may be distributed among States without regard to distribution of funds formulas of section 15 of this Act. The program authorized under this subsection shall be in addition to, and not in substitution of, other programs in such area authorized by this or any other Act. (16 U. S. C. 590p (b))

SCOPE OF ACT; DEFINITION OF STATE

SEC. 17. (a) This Act shall apply to the United States, the Territories of Alaska and Hawaii, and the possessions of Puerto Rico and the Virgin Islands, and, as used in this Act, the term "State" includes Alaska, Hawaii, Puerto Rico, and the Virgin Islands. (16 U. S. C. 590q (a).)

(b) This Act may be cited as the "Soil Conservation and Domestic Allotment Act." (16 U. S. C. 590q (b).)

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AGRICULTURAL ADJUSTMENT ACT OF 1938, AS AMENDED

EXPLANATORY NOTE

As enacted on February 16, 1938, this statute contained amendments which strengthened and broadened the Soil Conservation and Domestic Allotment Act, provided for assistance in the marketing of agricultural commodities for domestic consumption and export, provided for price support loans on wheat, corn, cotton and other agricultural commodities, authorized parity payments for corn, wheat, tobacco, cotton and rice, when funds were appropriated therefor, provided for farm marketing quotas for tobacco, corn, wheat, cotton and rice, and established the Federal Crop Insurance Corporation. The act has been amended many times since its enactment. In 1941, marketing quota and price support provisions for peanuts were added to the act and the marketing quota provisions for corn and wheat were changed in several important respects. In 1949, substantial changes were made in the marketing quota provisions for cotton and rice, and the price support provisions were repealed with the enactment of the Agricultural Act of 1949. The Agricultural Act of 1954 repealed the authority for marketing quotas for corn, but authority for corn acreage allotments was retained. The Agricultural Act of 1956 made a number of changes in the marketing quota provisions for several commodities. In accordance with section 201 of the Agricultural Act of 1958, acreage allotments and a commercial corn-producing area will not be established for the 1959 and subsequent crops of corn, since a majority of the corn producers voting in the referendum held on November 25, 1958, favored a price support program without acreage allotments, as provided in section 104 (b) of the Agricultural Act of 1949 (p. 124), as added by the Agricultural Act of 1958.

The constitutional validity of the marketing quota provisions has been upheld as to tobacco in the case *Mulford* v. *Smith* (307 U. S. 38), as to cotton in the case *Troppy* v. *La Sara Farmers Gin Co.* (113 F. 2d 350), and as to wheat in the case *Wickard* v. *Filburn* (317 U. S. 111).

PART II

AGRICULTURAL ADJUSTMENT ACT OF 1938,[1] AS AMENDED

AN ACT

To provide for the conservation of national soil resources and to provide an adequate and balanced flow of agricultural commodities in interstate and foreign commerce and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Agricultural Adjustment Act of 1938." (7 U. S. C. 1281.)

DECLARATION OF POLICY

SEC. 2. It is hereby declared to be the policy of Congress to continue the Soil Conservation and Domestic Allotment Act, as amended, for the purpose of conserving national resources, preventing the wasteful use of soil fertility, and of preserving, maintaining, and rebuilding the farm and ranch land resources in the national public interest; to accomplish these purposes through the encouragement of soil-building and soil-conserving crops and practices; to assist in the marketing of agricultural commodities for domestic consumption and for export; and to regulate interstate and foreign commerce in cotton, wheat, corn, tobacco, and rice to the extent necessary to provide an orderly, adequate, and balanced flow of such commodities in interstate and foreign commerce through storage of reserve supplies, loans, marketing quotas, assisting farmers to obtain, insofar as practicable, parity prices for such commodities and parity of income, and assisting consumers to obtain an adequate and steady supply of such commodities at fair prices. (7 U. S. C. 1282.)

TITLE I—AMENDMENTS TO SOIL CONSERVATION AND DOMESTIC ALLOTMENT ACT

This title contains amendments to the Soil Conservation and Domestic Allotment Act, as amended. Insofar as now applicable, these amendments are incorporated in Part I of this compilation.

TITLE II—ADJUSTMENT IN FREIGHT RATES, NEW USES AND MARKETS, AND DISPOSITION OF SURPLUSES

ADJUSTMENTS IN FREIGHT RATES FOR FARM PRODUCTS

SEC. 201. (a) The Secretary of Agriculture is authorized to make complaint to the Interstate Commerce Commission with respect to

[1] Approved February 16, 1938, 52 Stat. 31.

rates, charges, tariffs, and practices relating to the transportation of farm products, and to prosecute the same before the Commission. Before hearing or disposing of any complaint (filed by any person other than the Secretary) with respect to rates, charges, tariffs, and practices relating to the transportation of farm products, the Commission shall cause the Secretary to be notified, and, upon application by the Secretary, shall permit the Secretary to appear and be heard. (7 U. S. C. 1291 (a).)

(b) If such rate, charge, tariff, or practice complained of is one affecting the public interest, upon application by the Secretary, the Commission shall make the Secretary a party to the proceeding. In such case the Secretary shall have the rights of a party before the Commission and the rights of a party to invoke and pursue original and appellate judicial proceedings involving the Commission's determination. The liability of the Secretary in any such case shall extend only to liability for court costs. (7 U. S. C. 1291 (b).)

(c) For the purposes of this section, the Interstate Commerce Commission is authorized to avail itself of the cooperation, records, services, and facilities of the Department of Agriculture. (7 U. S. C. 1291 (c).)

(d) The Secretary is authorized to cooperate with and assist cooperative associations of farmers making complaint to the Interstate Commerce Commission with respect to rates, charges, tariffs, and practices relating to the transportation of farm products. (7 U. S. C. 1291 (d).)

NEW USES AND NEW MARKETS FOR FARM COMMODITIES

SEC. 202. (a) The Secretary is hereby authorized and directed to establish, equip, and maintain four regional research laboratories, one in each major farm producing area, and, at such laboratories, to conduct researches into and to develop new scientific, chemical, and technical uses and new and extended markets and outlets for farm commodities and products and byproducts thereof. Such research and development shall be devoted primarily to those farm commodities in which there are regular or seasonal surpluses, and their products and byproducts. (7 U. S. C. 1292 (a).)

(b) For the purposes of subsection (a), the Secretary is authorized to acquire land and interests therein, and to accept in the name of the United States donations of any property, real or personal, to any laboratory established pursuant to this section, and to utilize voluntary or uncompensated services at such laboratories. Donations to any one of such laboratories shall not be available for use by any other of such laboratories. (7 U. S. C. 1292 (b).)

(c) In carrying out the purposes of subsection (a), the Secretary is authorized and directed to cooperate with other departments or agencies of the Federal Government, States, State agricultural experiment stations, and other State agencies and institutions, counties, municipalities, business or other organizations, corporations, associations, universities, scientific societies, and individuals, upon such terms and conditions as he may prescribe. (7 U. S. C. 1292 (c).)

(d) To carry out the purposes of subsection (a), the Secretary is authorized to utilize in each fiscal year, beginning with the fiscal year

beginning July 1, 1938, a sum not to exceed $4,000,000 of the funds appropriated pursuant to section 391 of this Act, or section 15 of the Soil Conservation and Domestic Allotment Act, as amended, for such fiscal year. The Secretary shall allocate one-fourth of such sum annually to each of the four laboratories established pursuant to this section. (7 U. S. C. 1292 (d).)

(e) [Repealed by the Act of August 30, 1954, 68 Stat. 966.]

(f) There is hereby allocated to the Secretary of Commerce for each fiscal year, beginning with the fiscal year beginning July 1, 1938, out of funds appropriated for such fiscal year pursuant to section 391 of this Act, or section 15 of the Soil Conservation and Domestic Allotment Act, as amended, the sum of $1,000,000 to be expended for the promotion of the sale of farm commodities and products thereof in such manner as he shall direct. Of the sum allocated under this subsection to the Secretary of Commerce for the fiscal year beginning July 1, 1938, $100,000 shall be devoted to making a survey and investigation of the cause or causes of the reduction in exports of agricultural commodities from the United States, in order to ascertain methods by which the sales in foreign countries of basic agricultural commodities produced in the United States may be increased. (7 U. S. C. 1292 (f).)

(g) It shall be the duty of the Secretary to use available funds to stimulate and widen the use of all farm commodities in the United States and to increase in every practical way the flow of such commodities and the products thereof into the markets of the world. (7 U. S. C. 1292 (g).)

TITLE III—LOANS, PARITY PAYMENTS, CONSUMER SAFEGUARDS, MARKETING QUOTAS, AND MARKETING CERTIFICATES

SUBTITLE A—DEFINITIONS, PARITY PAYMENTS, AND CONSUMER SAFEGUARDS

DEFINITIONS

SEC. 301. (a) GENERAL DEFINITIONS.—For the purposes of this title and the declaration of policy—

(1) (A) The "parity price" for any agricultural commodity, as of any date, shall be determined by multiplying the adjusted base price of such commodity as of such date by the parity index as of such date.

(B) The "adjusted base price" of any agricultural commodity, as of any date, shall be (i) the average of the prices received by farmers for such commodity, at such times as the Secretary may select during each year of the ten-year period ending on the 31st of December last before such date, or during each marketing season beginning in such period if the Secretary determines use of a calendar year basis to be impracticable, divided by (ii) the ratio of the general level of prices received by farmers for agricultural commodities during such period to the general level of prices received by farmers for agricultural commodities during the period January 1910 to December 1914, inclusive. As used in this subparagraph, the term "prices" shall include wartime

subsidy payments made to producers under programs designed to maintain maximum prices established under the Emergency Price Control Act of 1942.

(C) The "parity index," as of any date, shall be the ratio of (i) the general level of prices for articles and services that farmers buy, wages paid hired farm labor, interest on farm indebtedness secured by farm real estate, and taxes on farm real estate, for the calendar month ending last before such date to (ii) the general level of such prices, wages, rates, and taxes during the period January 1910 to December 1914, inclusive.

(D) The prices and indices provided for herein, and the data used in computing them, shall be determined by the Secretary, whose determination shall be final.

(E) Notwithstanding the provisions of subparagraph (A), the transitional parity price for any agricultural commodity, computed as provided in this subparagraph, shall be used as the parity price for such commodity until such date after January 1, 1950, as such transitional parity price may be lower than the parity price, computed as provided in subparagraph (A), for such commodity. The transitional parity price for any agricultural commodity as of any date shall be—

(i) its parity price determined in the manner used prior to the effective date of the Agricultural Act of 1948, less

(ii) 5 per centum of the parity price so determined, multiplied by the number of full calendar years (not counting 1956 in the case of basic agricultural commodities) which, as of such date, have elapsed after January 1, 1949, in the case of nonbasic agricultural commodities, and after January 1, 1955, in the case of the basic agricultural commodities.

(F) Notwithstanding the provisions of subparagraphs (A) and (E), if the parity price for any agricultural commodity, computed as provided in subparagraphs (A) and (E) appears to be seriously out of line with the parity prices of other agricultural commodities, the Secretary may, and upon the request of a substantial number of interested producers shall, hold public hearings to determine the proper relationship between the parity price of such commodity and the parity prices of other agricultural commodities. Within sixty days after commencing such hearing the Secretary shall complete such hearing, proclaim his findings as to whether the facts require a revision of the method of computing the parity price of such commodity, and put into effect any revision so found to be required.

(G) Notwithstanding the foregoing provisions of this section, the parity price for any basic agricultural commodity, as of any date during the six-year period beginning January 1, 1950, shall not be less than its parity price computed in the manner used prior to the enactment of the Agricultural Act of 1949.

[Prior to enactment of the Agricultural Acts of 1948 and 1949, the term "parity" was defined in sec. 301 (a) of the Agricultural Adjustment Act of 1938, as amended, as follows: "'Parity,' as applied to prices for any agricultural commodity, shall be that price for the commodity which will give to the commodity a purchasing power with respect to articles that farmers buy equivalent to the purchasing power of such commodity in the base period; and, in the case of all commodities for which the base period is the period August 1909 to

July 1914, which will also reflect current interest payments per acre on farm indebtedness secured by real estate, tax payments per acre on farm real estate, and freight rates, as contrasted with such interest payments, tax payments, and freight rates during the base period. The base period in case of all agricultural commodities except tobacco shall be the period August 1909 to July 1914. In the case of all kinds of tobacco except Burley and flue-cured such base period shall be the period August 1919 to July 1929, and, in the case of Burley and flue-cured tobacco, shall be the period August 1934 to July 1939; except that the August 1919–July 1929 base period shall be used in allocating any funds appropriated prior to September 1, 1940'."[2] (52 Stat. 38, 54 Stat. 1210.)]

(2) "Parity," as applied to income, shall be that gross income from agriculture which will provide the farm operator and his family with a standard of living equivalent to those afforded persons dependent upon other gainful occupation. "Parity" as applied to income from any agricultural commodity for any year, shall be that gross income which bears the same relationship to parity income from agriculture for such year as the average gross income from such commodity for the preceding ten calendar years bears to the average gross income from agriculture for such ten calendar years.

(3) The term "interstate and foreign commerce" means sale, marketing, trade, and traffic between any State or Territory or the District of Columbia or Puerto Rico, and any place outside thereof; or between points within the same State or Territory or within the District of Columbia or Puerto Rico, through any place outside thereof; or within any Territory or within the District of Columbia or Puerto Rico.

(4) The term "affect interstate and foreign commerce" means, among other things, in such commerce, or to burden or obstruct such commerce or the free and orderly flow thereof; or to create or tend to create a surplus of any agricultural commodity which burdens or obstructs such commerce or the free and orderly flow thereof.

(5) The term "United States" means the several States and Territories and the District of Columbia and Puerto Rico.

(6) The term "State" includes a Territory and the District of Columbia and Puerto Rico.

(7) The term "Secretary" means the Secretary of Agriculture, and the term "Department" means the Department of Agriculture.

(8) The term "person" means an individual, partnership, firm, joint-stock company, corporation, association, trust, estate, or any agency of a State.

(9) The term "corn" means field corn. (7 U. S. C. 1301 (a), Public Law 585, 82d Cong., approved July 17, 1952.)

[Agricultural Act of 1948. Sec. 302 (f). All references in other laws to—

(1) parity,
(2) parity prices,
(3) prices comparable to parity prices, or
(4) prices to be determined in the same manner as provided by the Agricultural Adjustment Act of 1938 prior to its amendment by this Act for the determination of parity prices,

[2] For Maryland tobacco the base period is August 1936 to July 1941 (62 Stat. 1248).

with respect to prices for agricultural commodities and products thereof, shall hereafter be deemed to refer to parity prices as determined in accordance with the provisions of sction 301 (a) (1) of the Agricultural Adjustment Act of 1938, as amended by this Act. (7 U. S. C. 1301a.)]

(b) DEFINITIONS APPLICABLE TO ONE OR MORE COMMODITIES.—For the purposes of this title—

(1) (A) "Actual production" as applied to any acreage of corn means the number of bushels of corn which the local committee determines would be harvested as grain from such acreage if all the corn on such acreage were so harvested. In case of a disagreement between the farmer and the local committee as to the actual production of the acreage of corn on the farm, or in case the local committee determines that such actual production is substantially below normal, the local committee, in accordance with regulations of the Secretary, shall weigh representative samples of ear corn taken from the acreage involved, make proper deductions for moisture content, and determine the actual production of such acreage on the basis of such samples.

(B) "Actual production" of any number of acres of cotton, rice or peanuts on a farm means the actual average yield for the farm times such number of acres.

(2) "Bushel" means in the case of ear corn that amount of ear corn, including not to exceed 15½ per centum of moisture content, which weighs seventy pounds, and in the case of shelled corn, means that amount of shelled corn including not to exceed 15½ per centum of moisture content, which weighs fifty-six pounds.

(3) (A) "Carry-over," in the case of corn, rice, and peanuts for any marketing year shall be the quantity of the commodity on hand in the United States at the beginning of such marketing year, not including any quantity which was produced in the United States during the calendar year then current.

[NOTE.—As originally enacted this term included domestically produced cotton on hand within or without the United States. A new definition, excluding American cotton on hand outside the United States, was enacted in Sec. 201 (c) of the Agricultural Act of 1948 (62 Stat. 1250). The definition was changed again by Sec. 2 (a) of Pub. L. 272, 81st Cong., approved August 29, 1949 (63 Stat. 675), to include all cotton on hand in the United States whether produced within or without the United States. Sec. 415 (e) of the Agricultural Act of 1949 (63 Stat. 1056) repealed Sec. 201 (c) of the Agricultural Act of 1948. Therefore, the provision now in effect is the definition appearing herein which is the definition enacted by Pub. L. 272, 81st Cong. Sec. 1301 (b) (3) (B) of Title 7, U. S. Code, 1946 ed., Supplement V carries the definition of the term as it was originally enacted.]

(B) "Carry-over" of cotton for any marketing year shall be the quantity of cotton on hand in the United States at the beginning of such marketing year, not including any part of the crop which was produced in the United States during the calendar year then current.

(C) "Carry-over" of tobacco for any marketing year shall be the quantity of such tobacco on hand in the United States at the beginning of such marketing year (or on January 1 of such marketing year in the case of Maryland tobacco), which was produced in the United States prior to the beginning of the calendar year in which such marketing year begins, except that in the case of cigar-filler and cigar-binder tobacco the quantity of type 46 on hand and theretofore pro-

duced in the United States during such calendar year shall also be included.

(D) "Carry-over" of wheat, for any marketing year shall be the quantity of wheat on hand in the United States at the beginning of such marketing year, not including any wheat which was produced in the United States during the calendar year then current, and not including any wheat held by the Federal Crop Insurance Corporation under Title V [of the Agricultural Adjustment Act of 1938].

(4) (A) "Commercial corn-producing area" shall include all counties in which the average production of corn (excluding corn used as silage) during the ten calendar years immediately preceding the calendar year for which such area is determined, after adjustment for abnormal weather conditions, is four hundred and fifty bushels or more per farm and four bushels or more for each acre of farm land in the county.

(B) Whenever prior to February 1 of any calendar year the Secretary has reason to believe that any county which is not included in the commercial corn-producing area determined pursuant to the provisions of subparagraph (A), but which borders upon one of the counties in such area, or that any minor civil division in a county bordering on such area, is producing (excluding corn used for silage) an average of at least four hundred and fifty bushels of corn per farm and an average of at least four bushels for each acre of farm land in the county or in the minor civil division, as the case may be, he shall cause immediate investigation to be made to determine such fact. If, upon the basis of such investigation, the Secretary finds that such county or minor civil division is likely to produce corn in such average amounts during such calendar year, he shall proclaim such determination, and, commencing with such calendar year, such county shall be included in the commercial corn-producing area. In the case of a county included in the commercial corn-producing area pursuant to this subparagraph, whenever prior to February 1 of any calendar year the Secretary has reason to believe that facts justifying the inclusion of such county are not likely to exist in such calendar year, he shall cause an immediate investigation to be made with respect thereto. If, upon the basis of such investigation, the Secretary finds that such facts are not likely to exist in such calendar year, he shall proclaim such determination, and commencing with such calendar year, such county shall be excluded from the commercial corn-producing area.

(5) "Farm consumption" of corn means consumption by the farmer's family, employees, or household, or by his work stock; or consumption by poultry or livestock on his farm if such poultry or livestock, or the products thereof, are consumed or to be consumed by the farmer's family, employees, or household.

(6) (A) "Market," in the case of corn, cotton, rice, tobacco, and wheat, means to dispose of, in raw or processed form, by voluntary or involuntary sale, barter, or exchange, or by gift inter vivos, and, in the case of corn and wheat, by feeding (in any form) to poultry or livestock which, or the products of which, are sold, bartered, or exchanged, or to be so disposed of, but does not include disposing of any of such commodities as premium to the Federal Crop Insurance Corporation under Title V [of the Agricultural Adjustment Act of 1938].

(B) "Marketed," "marketing," and "for market" shall have corresponding meanings to the term "market" in the connection in which they are used.

(C) "Market," in the case of peanuts, means to dispose of peanuts, including farmers' stock peanuts, shelled peanuts, cleaned peanuts, or peanuts in processed form, by voluntary or involuntary sale, barter, or exchange, or by gift inter vivos.

(7) "Marketing year" means, in the case of the following commodities, the period beginning on the first and ending with the second date specified below:

Corn, October 1–September 30;
Cotton, August 1–July 31;
Rice, August 1–July 31;
Tobacco (flue-cured), July 1–June 30;
Tobacco (other than flue-cured), October 1–September 30;
Wheat, July 1–June 30.
[Peanuts, August 1–July 31 (see Sec. 359 (a), p. 80).]

(8) "National average yield" as applied to cotton or wheat shall be the national average yield per acre of the commodity during the ten calendar years in the case of wheat, and during the five calendar years in the case of cotton, preceding the year in which such national average yield is used in any computation authorized in this title, adjusted for abnormal weather conditions and, in the case of wheat, but not in the case of cotton, for trends in yields.

(9) "Normal production" as applied to any number of acres of corn, cotton, rice, or wheat means the normal yield for the farm times such number of acres.

(10) (A) "Normal supply" in the case of corn, rice, wheat, and peanuts for any marketing year shall be (i) the estimated domestic consumption of the commodity for the marketing year ending immediately prior to the marketing year for which normal supply is being determined, plus (ii) the estimated exports of the commodity for the marketing year for which normal supply is being determined, plus (iii) an allowance for carry-over. The allowance for carry-over shall be the following percentage of the sum of the consumption and exports used in computing normal supply: 15 per centum in the case of corn; 10 per centum in the case of rice; 20 per centum in the case of wheat; and 15 per centum in the case of peanuts. In determining normal supply the Secretary shall make such adjustments for current trends in consumption and for unusual conditions as he may deem necessary.

[NOTE.—Sec. 2 (a) (2) of the Act of Aug. 29, 1949 (63 Stat. 676), deleted "cotton" from the foregoing definition and added a new subparagraph (C) containing the definition of "normal supply" of cotton. The word "cotton" has not been omitted in the first sentence of sec. 1301 (b) (10) (A) of title 7 of the U. S. Code.]

(B) "Normal supply" in the case of tobacco shall be a normal year's domestic consumption and exports, plus 175 per centum of a normal year's domestic consumption and 65 per centum of a normal year's exports as an allowance for a normal carry-over.

(C) The "normal supply" of cotton for any marketing year shall be the estimated domestic consumption of cotton for the marketing

year for which such normal supply is being determined, plus the estimated exports of cotton for such marketing year, plus 30 per centum of the sum of such consumption and exports as an allowance for carry-over.

(11) (A) "Normal year's domestic consumption," in the case of corn and wheat, shall be the yearly average quantity of the commodity, wherever produced, that was consumed in the United States during the ten marketing years immediately preceding the marketing year in which such consumption is determined, adjusted for current trends in such consumption.

(B) "Normal year's domestic consumption," in the case of cotton and tobacco, shall be the yearly average quantity of the commodity produced in the United States that was consumed in the United States during the ten marketing years immediately preceding the marketing year in which such consumption is determined, adjusted for current trends in such consumption.

(C) "Normal year's domestic consumption," in the case of rice, shall be the yearly average quantity of rice produced in the United States that was consumed in the United States during the five marketing years immediately preceding the marketing year in which such consumption is determined, adjusted for current trends in such consumption.

(12) "Normal year's exports" in the case of corn, cotton, rice, tobacco, and wheat shall be the yearly average quantity of the commodity produced in the United States that was exported from the United States during the ten marketing years (or, in the case of rice, the five marketing years) immediately preceding the marketing year in which such exports are determined, adjusted for current trends in such exports.

(13) (A) "Normal yield" for any county, in the case of corn or wheat, shall be the average yield per acre of corn or wheat for the county during the ten calendar years in the case of wheat, or the five calendar years in the case of corn, immediately preceding the year in which such normal yield is determined, adjusted for abnormal weather conditions and, in the case of wheat, for trends in yields. Such normal yield per acre for any county need be redetermined only when the actual average yield for the ten calendar years in the case of wheat, or the five calendar years in the case of corn, immediately preceding the calendar year in which such yield is being reconsidered differs by at least 5 per centum from the actual average yield for the ten years in the case of wheat, or the 5 years in the case of corn, upon which the existing normal yield per acre for the county was based.

(B) "Normal yield" for any county, in the case of cotton or peanuts, shall be the average yield per acre of cotton or peanuts for the county, adjusted for abnormal weather conditions, during the five calendar years immediately preceding the year in which such normal yield is determined.

(C) In applying subparagraph (A) or (B), if for any such year the data are not available, or there is no actual yield, an appraised yield for such year, determined in accordance with regulations issued by the Secretary, shall be used as the actual yield for such year. In applying such subparagraphs, if, on account of drought, flood, insect

pests, plant disease, or other uncontrollable natural cause, the yield in any year of such ten-year period or five-year period, as the case may be, is less than 75 per centum of the average (computed without regard to such year) such year shall be eliminated in calculating the normal yield per acre.

(D) "Normal yield" for any county, in the case of rice, shall be the average yield per acre of rice for the county during the five calendar years immediately preceding the year for which such normal yield is determined, adjusted for abnormal weather conditions and for trends in yields. If for any such year data are not available, or there is no actual yield, an appraised yield for such year, determined in accordance with regulations issued by the Secretary, taking into consideration the yields obtained in surrounding counties during such year and the yield in years for which data are available, shall be used as the actual yield for such year.

(E) "Normal yield" for any farm, in the case of rice, shall be the average yield per acre of rice for the farm during the five calendar years immediately preceding the year for which such normal yield is determined, adjusted for abnormal weather conditions and for trends in yields. If for any such year the data are not available or there is no actual yield, then the normal yield for the farm shall be appraised in accordance with regulations issued by the Secretary, taking into consideration abnormal weather conditions, trends in yields, the normal yield for the county, the yields obtained on adjacent farms during such year and the yield in years for which data are available.

(F) In applying subparagraphs (D) and (E), if on account of drought, flood, insect pests, plant disease, or other uncontrollable natural cause, the yield for any year of such five-year period is less than 75 per centum of the average, 75 per centum of such average shall be substituted therefor in calculating the normal yield per acre. If, on account of abnormally favorable weather conditions, the yield for any year of such five-year period is in excess of 125 per centum of the average, 125 per centum of such average shall be substituted therefor in calculating the normal yield per acre.

(G) "Normal yield" for any farm, in the case of corn, wheat, cotton, or peanuts, shall be the average yield per acre of corn, wheat, cotton, or peanuts, as the case may be, for the farm, adjusted for abnormal weather conditions and, in the case of wheat, but not in the case of corn, cotton, or peanuts, for trends in yields, during the ten calendar years in the case of wheat, and five calendar years in the case of corn, cotton, or peanuts, immediately preceding the year in which such normal yield is determined. If for any such year the data are not available or there is no actual yield, then the normal yield for the farm shall be appraised in accordance with regulations of the Secretary, taking into consideration abnormal weather conditions, the normal yield for the county, and the yield in years for which data are available.

(14) (A) "Reserve supply level," in the case of corn, shall be a normal year's domestic consumption and exports of corn plus 10 per centum of a normal year's domestic consumption and exports, to insure a supply adequate to meet domestic consumption and export needs in years of drought, flood, or other adverse conditions, as well as in years of plenty.

(B) "Reserve supply level" of tobacco shall be the normal supply plus 5 per centum thereof, to insure a supply adequate to meet domestic consumption and export needs in years of drought, flood, or other adverse conditions, as well as in years of plenty.

(15) "Tobacco" means each one of the kinds of tobacco listed below comprising the types specified as classified in Service and Regulatory Announcement Numbered 118 of the Bureau of Agricultural Economics of the Department:

Flue-cured tobacco, comprising types 11, 12, 13, and 14;
Fire-cured tobacco, comprising types 21, 22, 23, and 24;
Dark air-cured tobacco, comprising types 35 and 36;
Virginia sun-cured tobacco, comprising type 37;
Burley tobacco, comprising type 31;
Maryland tobacco, comprising type 32;
Cigar-filler and cigar-binder tobacco, comprising types 42, 43, 44, 45, 46, 51, 52, 53, 54, and 55;
Cigar-filler tobacco, comprising type 41.

The provisions of this title shall apply to each of such kinds of tobacco severally: *Provided*, That any one or more of the types comprising any such kind of tobacco shall be treated as a "kind of tobacco" for the purposes of this Act if the Secretary finds there is a difference in supply and demand conditions as among such types of tobacco which results in a difference in the adjustments needed in the marketings thereof in order to maintain supplies in line with demand: *Provided further, That with respect to the 1958 and subsequent crops, type 21 (Virginia) fire-cured tobacco shall be treated as a "kind of tobacco" for the purposes of all of the provisions of this title, except that for the purposes of section 312 (c) of this title, types 21, 22, and 23, fire-cured tobacco shall be treated as one "kind of tobacco".*[3]

(16) (A) "Total supply" of wheat, corn, rice, and peanuts for any marketing year shall be the carry-over of the commodity for such marketing year, plus the estimated production of the commodity in the United States during the calendar year in which such marketing year begins and the estimated imports of the commodity into the United States during such marketing year.

(B) "Total supply" of tobacco for any marketing year shall be the carry-over at the beginning of such marketing year (or on January 1 of such marketing year in the case of Maryland tobacco) plus the estimated production thereof in the United States during the calendar year in which such marketing year begins, except that the estimated production of type-46 tobacco during the marketing year with respect to which the determination is being made shall be used in lieu of the estimated production of such type during the calendar year in which such marketing year begins in determining the total supply of cigar-filler and cigar-binder tobacco.

(C) "Total supply" of cotton for any marketing year shall be the carry-over at the beginning of such marketing year, plus the estimated production of cotton in the United States during the calendar year in which such marketing year begins and the estimated imports of cotton into the United States during such marketing year. (7 U. S. C. 1301 (b).)

[3] Material in italics enacted by Pub. L. 85–92, 71 Stat. 284, July 10, 1957.

(c) The latest available statistics of the Federal Government shall be used by the Secretary in making the determinations required to be made by the Secretary under this Act. (7 U. S. C. 1301 (c).)

(d) In making any determination under this Act or under the Agricultural Act of 1949 with respect to the carryover of any agricultural commodity, the Secretary shall exclude from such determination the stocks of any commodity acquired pursuant to, or under the authority of, the Strategic and Critical Materials Stock Piling Act (60 Stat. 596). (7 U. S. C. 1301 (d).)

SEC. 302. (Repealed by 63 Stat. 1051, October 31, 1949.)

PARITY PAYMENTS

SEC. 303. If and when appropriations are made therefor, the Secretary is authorized and directed to make payments to producers of corn, wheat, cotton, rice, or tobacco, on their normal production of such commodities in amounts which, together with the proceeds thereof, will provide a return to such producers which is as nearly equal to parity price as the funds so made available will permit. All funds available for such payments with respect to these commodities shall, unless otherwise provided by law, be apportioned to these commodities in proportion to the amount by which each fails to reach the parity income. Such payments shall be in addition to and not in substitution for any other payments authorized by law. (7 U. S. C. 1303.)

CONSUMER SAFEGUARDS

SEC. 304. The powers conferred under this Act shall not be used to discourage the production of supplies of foods and fibers sufficient to maintain normal domestic human consumption as determined by the Secretary from the records of domestic human consumption in the years 1920 to 1929, inclusive, taking into consideration increased population, quantities of any commodity that were forced into domestic consumption by decline in exports during such period, current trends in domestic consumption and exports of particular commodities, and the quantities of substitutes available for domestic consumption within any general class of food commodities. In carrying out the purposes of this Act it shall be the duty of the Secretary to give due regard to the maintenance of a continuous and stable supply of agricultural commodities from domestic production adequate to meet consumer demand at prices fair to both producers and consumers. (7 U. S. C. 1304.)

SUBTITLE B—MARKETING QUOTAS

PART I—MARKETING QUOTAS—TOBACCO

LEGISLATIVE FINDING

SEC. 311. (a) The marketing of tobacco constitutes one of the great basic industries of the United States with ramifying activities which directly affect interstate and foreign commerce at every point, and stable conditions therein are necessary to the general welfare. Tobacco produced for market is sold on a Nation-wide market and, with

its products, moves almost wholly in interstate and foreign commerce from the producer to the ultimate consumer. The farmers producing such commodity are subject in their operations to uncontrollable natural causes, are widely scattered throughout the Nation, in many cases such farmers carry on their farming operations on borrowed money or leased lands, and are not so situated as to be able to organize effectively, as can labor and industry through unions and corporations enjoying Government protection and sanction. For these reasons, among others, the farmers are unable without Federal assistance to control effectively the orderly marketing of such commodity with the result that abnormally excessive supplies thereof are produced and dumped indiscriminately on the Nation-wide market. (7 U. S. C. 1311 (a).)

(b) The disorderly marketing of such abnormally excessive supplies affects, burdens, and obstructs interstate and foreign commerce by (1) materially affecting the volume of such commodity marketed therein, (2) disrupting the orderly marketing of such commodity therein, (3) reducing the price for such commodity with consequent injury and destruction of interstate and foreign commerce in such commodity, and (4) causing a disparity between the prices for such commodity in interstate and foreign commerce and industrial products therein, with a consequent diminution of the volume of interstate and foreign commerce in industrial products. (7 U. S. C. 1311 (b).)

(c) Whenever an abnormally excessive supply of tobacco exists, the marketing of such commodity by the producers thereof directly and substantially affects interstate and foreign commerce in such commodity and its products, and the operation of the provisions of this Part becomes necessary and appropriate in order to promote, foster, and maintain an orderly flow of such supply in interstate and foreign commerce. (7 U. S. C. 1311 (c).)

NATIONAL MARKETING QUOTA

SEC. 312. (a) The Secretary shall, not later than December 1 of any marketing year with respect to flue-cured tobacco, and February 1 of any marketing year with respect to other kinds of tobacco, proclaim a national marketing quota for any kind of tobacco for each of the next three succeeding marketing years whenever he determines with respect to such kind of tobacco—

(1) that a national marketing quota has not previously been proclaimed and the total supply as of the beginning of such marketing year exceeds the reserve supply level therefor;

(2) that such marketing year is the last year of three consecutive years for which marketing quotas previously proclaimed will be in effect;

(3) that amendments have been made in provisions for establishing farm acreage allotments which will cause material revision of such allotments before the end of the period for which quotas are in effect; or

(4) that a marketing quota previously proclaimed for such marketing year is not in effect because of disapproval by producers in a referendum held pursuant to subsection (c) : *Provided*, That if such producers have disapproved national marketing

quotas in referenda held in three successive years subsequent to 1952, thereafter a national marketing quota shall not be proclaimed hereunder which would be in effect for any marketing year within the three-year period for which national marketing quotas previously proclaimed were disapproved by producers in a referendum, unless prior to November 10 of the marketing year one-fourth or more of the farmers engaged in the production of the crop of tobacco harvested in the calendar year in which such marketing year begins petition the Secretary, in accordance with such regulations as he may prescribe, to proclaim a national marketing quota for each of the next three succeeding marketing years. (7 U. S. C. 1312 (a).)

(b) The Secretary shall also determine and announce not later than the first day of December with respect to flue-cured tobacco and not later than the first day of February with respect to other kinds of tobacco, the amount of the national marketing quota proclaimed pursuant to subsection (a) which is in effect for the next marketing year in terms of the total quantity of tobacco which may be marketed which will make available during such marketing year a supply of tobacco equal to the reserve supply level. The amount of the national marketing quota so announced may, not later than the following March 1, be increased by not more than 20 per centum if the Secretary determines that such increase is necessary in order to meet market demands or to avoid undue restrictions of marketings in adjusting the total supply to the reserve supply level. (7 U. S. C. 1312 (b).)

(c) Within thirty days after the proclamation of national marketing quotas under subsection (a), the Secretary shall conduct a referendum of farmers engaged in the production of the crop of tobacco harvested immediately prior to the holding of the referendum to determine whether such farmers are in favor of or opposed to such quotas for the next three succeeding marketing years. If more than one-third of the farmers voting oppose the national marketing quotas, such results shall be proclaimed by the Secretary and the national marketing quotas so proclaimed shall not be in effect but such results shall in no wise affect or limit the subsequent proclamation and submission to a referendum, as otherwise provided in this section, of a national marketing quota. (7 U. S. C. 1312 (c).)

[Act of March 31, 1955. Sec. 1. * * * That notwithstanding any other provision of law—

(1) The Secretary of Agriculture shall, within ten days after enactment of this Act, redetermine the national marketing quota for burley tobacco for the 1955–1956 marketing year on the basis of the latest available statistics of the Federal Government, apportion such quota among States, convert the State quotas to State acreage allotments, and allot the same among farms pursuant to and in accordance with applicable provisions of law: *Provided*, That burley tobacco marketing quotas and acreage allotments heretofore established for the 1955–1956 marketing year shall not be effective, but the preliminary burley tobacco acreage allotment for any farm determined under section 725.616 of the burley and flue-cured tobacco marketing quota regulations, 1955–1956 mar-

keting year, issued by the Secretary of Agriculture (19 Federal Register 3549), shall not be reduced by more than 25 per centum (except for reductions under section 725.619 of said regulations);

(2) Burley tobacco farm acreage allotments of seven-tenths of an acre or less heretofore determined for the 1955–1956 marketing year when redetermined pursuant to paragraph (1) of this Act may be reduced but not more than one-tenth acre: *Provided, however*, That no allotment of five-tenths of an acre or less shall be reduced under this section;

(3) Within twenty days after the issuance of the proclamation of the national marketing quota for burley tobacco for the 1955–1956 marketing year as redetermined pursuant to paragraph (1) of this Act, the Secretary of Agriculture shall conduct a referendum of farmers who were engaged in the production of the 1954 crop of burley tobacco to determine whether such farmers are in favor of or opposed to such redetermined quota. If more than one-third of the farmers voting in the referendum oppose such redetermined quota, the Secretary of Agriculture shall, within thirty days after the date of the referendum, proclaim the result of the referendum and (1) no quota for burley tobacco for the 1955–1956 marketing year shall be effective thereafter, and (2) no price support shall be made available on the 1955 crop of burley tobacco. (7 U. S. C. 1312 note.)]

APPORTIONMENT OF NATIONAL MARKETING QUOTA

SEC. 313. (a) The national marketing quota for tobacco established pursuant to the provisions of section 312, less the amount to be allotted under subsection (c) of this section, shall be apportioned by the Secretary among the several States on the basis of the total production of tobacco in each State during the five calendar years immediately preceding the calendar year in which the quota is proclaimed (plus, in applicable years, the normal production on the acreage diverted under previous agricultural adjustment and conservation programs), with such adjustments as are determined to be necessary to make correction for abnormal conditions of production, for small farms, and for trends in production, giving due consideration to seed bed and other plant diseases during such five-year period. Notwithstanding any other provision of this section and section 312 * * * the burley tobacco acreage allotment which would otherwise be established for any farm having a burley acreage allotment in 1942 shall not be less than one-half acre, and the acreage required for apportionment under this proviso shall be in addition to the National and State acreage allotments. (7 U. S. C. 1313 (a).)

[Act of March 31, 1944. * * * notwithstanding the provisions of section 313 (a) of the Agricultural Adjustment Act of 1938, as amended, the burley tobacco acreage allotment which would otherwise be established for any farm having a burley acreage allotment in 1943 shall not be less than one acre, or 25 per centum of the cropland, whichever is the smaller, and the acreage required for apportionment under this joint resolution shall be in addition to the National and State acreage allotments. (58 Stat. 136, 7 U. S. C. 1313 note.)]

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[Act of July 12, 1952. * * * notwithstanding any other provision of law, effective for the 1956 and subsequent crops of burley tobacco, the farm acreage allotment for burley tobacco for any year shall not be less than the smallest of (1) the allotment established for the farm for the immediately preceding year, (2) five-tenths of an acre, or (3) 10 per centum of the cropland: *Provided, however*, That no allotment of seven-tenths of an acre or less shall be reduced more than one-tenth of an acre in any one year. The additional acreage required under this Act shall be in addition to the State acreage allotments and the production on such acreage shall be in addition to the national marketing quota. (7 U. S. C. 1315.)][4]

(b) The Secretary shall provide, through the local communities, for the allotment of the marketing quota for any State among the farms on which tobacco is produced, on the basis of the following: Past marketing of tobacco, making due allowance for drought, flood, hail, other abnormal weather conditions, plant bed, and other diseases; land, labor, and equipment available for the production of tobacco; crop-rotation practices; and the soil and other physical factors affecting the production of tobacco: *Provided*, That, except for farms on which for the first time in five years tobacco is produced to be marketed in the marketing year for which the quota is effective, the marketing quota for any farm shall not be less than the smaller of either (1) three thousand two hundred pounds, in the case of flue-cured tobacco, and two thousand four hundred pounds, in the case of other kinds of tobacco, or (2) the average tobacco production for the farm during the preceding three years, plus the average normal production of any tobacco acreage diverted under agricultural adjustment and conservation programs during such preceding three years. (7 U. S. C. 1313 (b).)

(c) The Secretary shall provide, through local committees, for the allotment of not in excess of 5 per centum of the national marketing quota (1) to farms in any State whether it has a State quota or not on which for the first time in five years tobacco is produced to be marketed in the year for which the quota is effective and (2) for further increase of allotments to small farms pursuant to the proviso in subsection (b) of this section on the basis of the following: Land, labor, and equipment available for the production of tobacco; crop-rotation practices; and the soil and other physical factors affecting the production of tobacco: *Provided*, That farm marketing quotas established pursuant to this subsection for farms on which tobacco is produced for the first time in five years shall not exceed 75 per centum of the farm marketing quotas established pursuant to subsection (b) of this section for farms which are similar with respect to the following: Land, labor, and equipment available for the production of tobacco, crop-rotation practices, and the soil and other physical factors affecting the production of tobacco. (7 U. S. C. 1313 (c).)

[ACT OF MARCH 2, 1956.—* * * That, notwithstanding any other provision of law and the proclamation by the Secretary of Agriculture of a national marketing quota for burley tobacco for the 1956–1957 marketing year pursuant to section 312 of the Agricultural Adjustment Act of 1938, as amended, and the State and farm acreage allot-

[4] Act of July 12, 1952, was amended by the Act of March 31, 1955 (69 Stat. 24).

ments established pursuant thereto, the 1956 State acreage allotments of burley tobacco proclaimed by the Secretary of Agriculture (20 Federal Register 8845) shall be increased so as to result in a State adjustment factor for each State under section 725.717 of the burley and flue-cured tobacco marketing quota regulations, 1956–1957 marketing year, issued by the Secretary of Agriculture (20 Federal Register 4571), equal to 1.0, and all 1956 farm acreage allotments of burley tobacco shall be redetermined on the basis of such State adjustment factor. The production from the increased acreage required by this resolution shall be in addition to the national marketing quota for the 1956–1957 marketing year. (70 Stat. 34, 7 U. S. C. 1312 note.)]

[ACT OF MARCH 2, 1956.—* * * That, notwithstanding any other provision of law and the proclamation by the Secretary of Agriculture of a national marketing quota for fire-cured and dark air-cured tobacco for the 1956–1957 marketing year pursuant to section 312 of the Agricultural Adjustment Act of 1938, as amended, and the State and farm acreage allotments established pursuant thereto, the 1956 State acreage allotments of fire-cured and dark air-cured tobacco proclaimed by the Secretary of Agriculture (20 Federal Register 8846) shall be increased so as to result in a State adjustment factor for each State under section 726.717 of the fire-cured, dark air-cured and Virginia sun-cured tobacco marketing quota regulations, 1956–1957 marketing year, issued by the Secretary of Agriculture (20 Federal Register 6066), equal to 1.0, and all 1956 farm acreage allotments of fire-cured and dark air-cured tobacco shall be redetermined on the basis of such State adjustment factor. The production from the increased acreage required by this resolution shall be in addition to the national marketing quota for the 1956–1957 marketing year. (70 Stat. 34, 7 U. S. C. 1312 note.)]

[ACT OF MARCH 2, 1956.—* * * That, notwithstanding any other provision of law and the proclamation by the Secretary of Agriculture of a national marketing quota for Maryland tobacco for the 1956–1957 marketing year pursuant to section 312 of the Agricultural Adjustment Act of 1938, as amended, and the State and farm acreage allotments established pursuant thereto, the 1956 State acreage allotments of Maryland tobacco proclaimed by the Secretary of Agriculture (20 Federal Register 8847) shall be increased so as to result in a State adjustment factor for each State under section 727.717 of the Maryland tobacco marketing quota regulations, 1956–1957 marketing year, issued by the Secretary of Agriculture (20 Federal Register 6069), equal to 1.0, and all 1956 farm acreage allotments of Maryland tobacco shall be redetermined on the basis of such State adjustment factor. The production from the increased acreage required by this resolution shall be in addition to the national marketing quota for the 1956–1957 marketing year. (70 Stat. 35, 7 U. S. C. 1312 note.)]

(d) Farm marketing quotas may be transferred only in such manner and subject to such conditions as the Secretary may prescribe by regulations. (7 U. S. C. 1313 (d).)

(e) In case of flue-cured tobacco, the national quota for 1938 is increased by a number of pounds required to provide for each State in addition to the State poundage allotment a poundage not in excess of 4 per centum of the allotment which shall be apportioned in amounts

which the Secretary determines to be fair and reasonable to farms in the State receiving allotments under the Agricultural Adjustment Act of 1938 which the Secretary determines are inadequate in view of past production of tobacco, and for each year by a number of pounds sufficient to assure that any State receiving a State poundage allotment of flue-cured tobacco shall receive a minimum State poundage allotment of flue-cured tobacco equal to the average national yield for the preceding five years of five hundred acres of such tobacco. (7 U. S. C. 1313 (e).)

(f) (Applicable only to 1938 crop.)

(g) Notwithstanding any other provision of this section, the Secretary on the basis of average yield per acre of tobacco for the State during the five years last preceding the year in which the national marketing quota is proclaimed, adjusted for abnormal conditions of production, may convert the State marketing quota into a State acreage allotment, and allot the same through the local committees among farms on the basis of the factors set forth in subsection (b), using past acreage (harvested and diverted) in lieu of the past marketing of tobacco; and the Secretary on the basis of the national average yield during the same period, similarly adjusted, may also convert into an acreage allotment the amount reserved from the national quota pursuant to the provisions of subsection (c), and on the basis of the factors set forth in subsection (c) and the past tobacco experience of the farm operator, allot the same through the local committees among farms on which no tobacco was produced during the last five years. Any acreage of tobacco harvested in excess of the farm acreage allotment for the year 1955, or any subsequent crop shall not be taken into account in establishing State and farm acreage allotments. Except for farms last mentioned or a farm operated, controlled, or directed by a person who also operates, controls, or directs another farm on which tobacco is produced, the farm-acreage allotment shall be increased by the smaller of (1) 20 per centum of such allotment or (2) the percentage by which the normal yield of such allotment (as determined through the local committees in accordance with regulations prescribed by the Secretary) is less than three thousand two hundred pounds, in the case of flue-cured tobacco, and two thousand four hundred pounds in the case of other kinds of tobacco: *Provided*, That the normal yield of the estimated number of acres so added to farm acreage allotments in any State shall be considered as a part of the State marketing quota in applying the proviso in subsection (a). The actual production of the acreage allotment established for a farm pursuant to this subsection shall be the amount of the farm marketing quota. If any amount of tobacco shall be marketed as having been produced on the acreage allotment for any farm which in fact was produced on a different farm, the acreage allotments next established for both such farms shall be reduced by that percentage which such amount was of the respective farm marketing quota, except that such reduction for any such farm shall not be made if the Secretary through the local committees finds that no person connected with such farm caused, aided, or acquiesced in such marketing; and if proof of the disposition of any amount of tobacco is not furnished as required by the Secretary, or if any producer on the farm files, or aids or

acquiesces in the filing of, any false report with respect to the acreage of tobacco grown on the farm required by regulations issued pursuant to this Act, the acreage allotment next established for the farm on which such tobacco is produced shall be reduced by a percentage similarly computed. *If in any calendar year more than one crop of tobacco is grown from (1) the same tobacco plants or (2) different tobacco plants, and is harvested for marketing from the same acreage of a farm, the acreage allotment next established for such farm shall be reduced by an amount equivalent to the acreage from which more than one crop of tobacco has been so grown and harvested.*[5] (Portion in italics effective beginning with the 1958 crop of tobacco.) (7 U. S. C. 1313 (g).)

(h) (Repealed by Pub. L. 85–835, 72 Stat. 988, August 28, 1958.) [6]

(i) Notwithstanding any other provision of this Act, whenever after investigation the Secretary determines with respect to any kind of tobacco that a substantial difference exists in the usage or market outlets for any one or more of the types comprising such kind of tobacco and that the quantity of tobacco of such type or types to be produced under the marketing quotas and acreage allotments established pursuant to this section would not be sufficient to provide an adequate supply for estimated market demands and carry-over requirements for such type or types of tobacco, the Secretary shall increase the marketing quotas and acreage allotments for farms producing such type or types of tobacco in the preceding year to the extent necessary to make available a supply of such type or types of tobacco adequate to meet such demands and carry-over requirements. The increases in farm marketing quotas and acreage allotments shall be made on the basis of the production of such type or types of tobacco during the period of years considered in establishing farm marketing quotas and acreage allotments for such kind of tobacco. The additional production authorized by this subsection shall be in addition to the national marketing quota established for such kind of tobacco pursuant to section 312 of this Act. The increase in acreage under this subsection shall not be considered in establishing future State or farm acreage allotments. (7 U. S. C. 1313 (i).)

(j) In establishing farm acreage allotments for burley tobacco crops for the years 1956, 1957, and 1958 the acreage allotment for any farm which has not been retired from agricultural production shall not be reduced below the acreage allotment which would otherwise be established because the harvested acreage was less than the allotted acreage unless the acreage harvested was less than 50 per centum of the allotted acreage in each of the preceding five years, in which event it shall not be reduced for such reason to less than the largest acreage harvested in any year in such five-year period.[7] (7 U. S. C. 1313 (j).)

(j) [sic] The production of tobacco on a farm in 1955 or any subsequent year for which no farm acreage allotment was established shall not make the farm eligible for an allotment as an old farm under subsections (b) and (g) hereof: *Provided, however*, That by reason of such production the farm need not be considered as ineligible for a new farm allotment under subsections (c) and (g) hereof, but such

[5] Material in italics enacted by Pub. L. 85–489, 72 Stat. 291, July 2, 1958.
[6] See p. 87 for section 378 which replaces this section.
[7] Subsec. (j) to sec. 313 was added by Act of August 11, 1955 (69 Stat. 670).

production shall not be deemed past tobacco experience for any producer on the farm.[8] (7 U. S. C. 1313 (j).)

PENALTIES

SEC. 314. (a) The marketing of any kind of tobacco in excess of the marketing quota for the farm on which the tobacco is produced shall be subject to a penalty of 75 [9] per centum of the average market price (calculated to the nearest whole cent) for such kind of tobacco for the immediately preceding marketing year. Such penalty shall be paid by the person who acquired such tobacco from the producer but an amount equivalent to the penalty may be deducted by the buyer from the price paid to the producer in case such tobacco is marketed by sale; or, if the tobacco is marketed by the producer through a warehouseman or other agent, such penalty shall be paid by such warehouseman or agent who may deduct an amount equivalent to the penalty from the price paid to the producer: *Provided*, That in case any tobacco is marketed directly to any person outside the United States the penalty shall be paid and remitted by the producer. If any producer falsely identifies or fails to account for the disposition of any tobacco, an amount of tobacco equal to the normal yield of the number of acres harvested in excess of the farm-acreage allotment shall be deemed to have been marketed in excess of the marketing quota for the farm, and the penalty in respect thereof shall be paid and remitted by the producer. Tobacco carried over by the producer thereof from one marketing year to another may be marketed without payment of the penalty imposed by this section if the total amount of tobacco available for marketing from the farm in the marketing year from which the tobacco is carried over did not exceed the farm marketing quota established for the farm for such marketing year (or which would have been established if marketing quotas had been in effect for such marketing year), or if the tobacco so carried over does not exceed the normal production of that number of acres by which the harvested acreage of tobacco in the calendar year in which the marketing year begins is less than the farm acreage allotment. Tobacco produced in a calendar year in which marketing quotas are in effect for the marketing year beginning therein shall be subject to such quotas even though it is marketed prior to the date on which such marketing year begins. (7 U. S. C. 1314 (a).)

(b) The Secretary shall require collection of the penalty upon a proportion of each lot of tobacco marketed from the farm equal to the proportion which the tobacco available for marketing from the farm in excess of the farm marketing quota is of the total amount of tobacco available for marketing from the farm if satisfactory proof is not furnished as to the disposition to be made of such excess tobacco prior to the marketing of any tobacco from the farm. All funds collected pursuant to this section shall be deposited in a special deposit account with the Treasurer of the United States until the end of the marketing year next succeeding that in which the funds are collected, and upon certification by the Secretary there shall be paid out

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[8] Subsec. (j) to sec. 313 was added by Act of August 11, 1955 (69 Stat. 684). To correct the error in paragraph designation requires congressional action.

[9] Penalty rate of 75 percent effective July 1, 1955, on flue-cured tobacco, and after October 1, 1955, on all other kinds of tobacco (69 Stat. 24).

of such special deposit account to persons designated by the Secretary the amount by which the penalty collected exceeds the amount of penalty due upon tobacco marketed in excess of the farm marketing quota for any farm. Such special account shall be administered by the Secretary, and the basis for, the amount of, and the person entitled to receive a payment from such account, when determined in accordance with regulations prescribed by the Secretary, shall be final and conclusive. (7 U. S. C. 1314 (b).)

Sec. 315. (a) The provisions of this section shall be effective. where applicable, notwithstanding any other provision of this Act. Within thirty days after the date this section is enacted into law, the Secretary shall conduct a special referendum of farmers who were engaged in the production of the crops of type 21 (Virginia) fire-cured tobacco or type 37 Virginia sun-cured tobacco which was harvested immediately prior to the referendum. The provisions of the regulations issued by the Secretary governing the holding of referendums on marketing quotas authorized under section 312 of this Act shall apply, insofar as applicable, to the holding of the special referendum provided for in this section. The purpose of such special referendum is to determine whether those persons eligible to vote therein favor the establishment, as hereinafter provided in this section, of a single combined tobacco acreage allotment for the 1958-59 and subsequent marketing years for any farm for which both a type 21 (Virginia) fire-cured tobacco acreage allotment and a type 37 Virginia sun-cured tobacco acreage allotment have been established for the 1958-59 marketing year.

(b) If two-thirds or more of the persons voting in the special referendum provided for in this section favor the establishment for the 1958–1959 and subsequent marketing years of a single combined tobacco acreage allotment for any farm having both a type 21 (Virginia) fire-cured tobacco acreage allotment and a type 37 Virginia sun-cured tobacco acreage allotment for the 1958–1959 marketing year, the Secretary, through local committees, shall establish for each of such farms a single combined tobacco acreage allotment for the 1958–1959 marketing year and subsequent marketing years applicable to one kind of tobacco, either type 21 (Virginia) fire-cured tobacco or type 37 Virginia sun-cured tobacco, whichever kind of tobacco the owner of such farm or his representative designates with respect to the 1958–1959 marketing year and notifies the local committee of such designation within a period of time as determined and fixed by the Secretary. In the absence of such a designation and notification by the owner or his representative of any farm for which a single combined tobacco acreage allotment shall be established as provided in this section, the Secretary shall designate such combined allotment for such farm as either a type 21 (Virginia) fire-cured tobacco acreage allotment or a type 37 Virginia sun-cured tobacco acreage allotment after taking into consideration the prevalent kind of tobacco grown in the area in which such farm is located, the curing facilities on such farm, and the proximity and nature of marketing outlets. The single combined tobacco acreage allotment determined as heretofore provided for each farm for the 1958–1959 marketing year shall be in lieu of and shall equal the total of the acreage of the type 21 (Virginia) fire-cured tobacco allotment and the acreage of the type

37 Virginia sun-cured tobacco allotment for the 1958–1959 marketing year established for such farm. No contract entered into under the acreage reserve program for the 1958 crop of type 21 (Virginia) fire-cured tobacco or of type 37 Virginia sun-cured tobacco shall be affected by the establishment of a single combined tobacco acreage allotment for a farm as provided in this section. If the establishment of farm acreage allotments as provided in this section are approved in the special referendum as heretofore provided in this section, and thereafter two or more farms, of which one or more has a type 21 (Virginia) fire-cured tobacco allotment and another or more has a type 37 Virginia sun-cured tobacco allotment, are combined and operated as a single farm, a single combined tobacco acreage allotment designated for either type 21 (Virginia) fire-cured tobacco or type 37 Virginia sun-cured tobacco as heretofore provided, shall be established for the combined farm in lieu of and shall equal the total acreage of the allotments for type 21 (Virginia) fire-cured tobacco and type 37 Virginia sun-cured tobacco established for the farms comprising the combined farm for the marketing year for which such single combined tobacco acreage allotment is established. For marketing years subsequent to the marketing year for which a single combined tobacco acreage allotment is first established for a farm as provided in this section, the history of past marketing or of past harvested acreage from such farm of both type 21 (Virginia) fire-cured tobacco and type 37 Virginia sun-cured tobacco shall constitute the past marketing of tobacco or the past harvested acreage of tobacco of such farm in determining a single combined tobacco acreage allotment therefor.

(c) Notwithstanding the national marketing quotas for the marketing year beginning October 1, 1958, announced by the Secretary for each of the two kinds of tobacco described as type 21 (Virginia) fire-cured tobacco and type 37 Virginia sun-cured tobacco, each of the State acreage allotments for such kinds of tobacco apportioned by the Secretary to the State of Virginia for the marketing year beginning October 1, 1958, shall be increased or decreased respectively by the amount of acreage equivalent to the corresponding net total change in farm acreage allotments for each of such kinds of tobacco for such marketing year which result from the establishment of single combined tobacco farm acreage allotments as provided in this section. In determining and announcing the amount of the national marketing quotas for type 21 (Virginia) fire-cured tobacco, and type 37 Virginia sun-cured tobacco in terms of the total quantity of each of such kinds of tobacco which may be marketed during the marketing year beginning October 1, 1959, and during each of the four succeeding marketing years thereafter, the Secretary shall increase or decrease such national marketing quotas determined as provided in section 312 (b) and the Virginia State acreage allotments for type 21 (Virginia) fire-cured tobacco and type 37 Virginia sun-cured tobacco to reflect correspondingly the changes which previously have occurred in the total acreage allotted for each of such kinds of tobacco pursuant to this section. Notwithstanding any marketing quota determined and announced for type 21 (Virginia) fire-cured tobacco and type 37 Virginia sun-cured tobacco for the marketing year beginning October 1, 1959, and for each marketing year thereafter, each of the State

acreage allotments for such kinds of tobacco apportioned to the State of Virginia for any such marketing year shall be increased or decreased respectively by the amount of acreage equivalent to the corresponding net total change in farm acreage allotments for each of such kinds of tobacco for such marketing year which results from the combination of farms and the establishment of single combined tobacco farm acreage allotments as provided in this section. The sum of the State acreage allotments for type 21 (Virginia) fire-cured tobacco and type 37 Virginia sun-cured tobacco determined for any marketing year as provided in section 313 shall not be increased or decreased by reason of any increase or decrease in the State acreage allotment for each of such kinds of tobacco previously provided for in this paragraph to reflect net changes occurring in acreage allotted.[10] (7 U. S. C. 1315.)

PART II—ACREAGE ALLOTMENTS—CORN [11]

LEGISLATIVE FINDING

SEC. 321. Corn is a basic source of food for the Nation, and corn produced in the commercial corn-producing area moves almost wholly in interstate and foreign commerce in the form of corn, livestock, and livestock products.

Abnormally excessive and abnormally deficient supplies of corn acutely and directly affect, burden, and obstruct interstate and foreign commerce in corn, livestock, and livestock products. When abnormally excessive supplies exist, transportation facilities in interstate and foreign commerce are overtaxed, and the handling and processing facilities through which the flow of interstate and foreign commerce in corn, livestock, and livestock products is directed become acutely congested. Abnormally deficient supplies result in substantial decreases in livestock production and in an inadequate flow of livestock and livestock products in interstate and foreign commerce, with the consequence of unreasonably high prices to consumers.

Violent fluctuations from year to year in the available supply of corn disrupt the balance between the supply of livestock and livestock products moving in interstate and foreign commerce and the supply of corn available for feeding. When available supplies of corn are excessive, corn prices are low and farmers overexpand livestock production in order to find outlets for corn. Such expansion, together with the relative scarcity and high price of corn, forces farmers to market abnormally excessive supplies of livestock in interstate commerce at sacrifice prices, endangering the financial stability of producers, and overtaxing handling and processing facilities through which the flow of interstate and foreign commerce in livestock and livestock products is directed. Such excessive marketings deplete livestock on farms, and livestock marketed in interstate and foreign commerce consequently becomes abnormally low, with resultant high prices to consumers and danger to the financial stability of persons engaged in transporting, handling, and processing livestock in inter-

[10] New section 315 added by Pub. L. 85–705, 72 Stat. 703, August 21, 1958.

[11] Sections 321 to 329 not in effect due to results of corn referendum held on November 25, 1958, in which farmers approved a price support program without acreage allotments. See section 104, Agricultural Act of 1958, p. 124, for corn price support program.

state and foreign commerce. These high prices in turn result in another overexpansion of livestock production.

Recurring violent fluctuations in the price of corn resulting from corresponding violent fluctuations in the supply of corn directly affect the movement of livestock in interstate commerce from the range cattle regions to the regions where livestock is fattened for market in interstate and foreign commerce, and also directly affect the movement in interstate commerce of corn marketed as corn which is transported from the regions where produced to the regions where livestock is fattened for market in interstate and foreign commerce.

Substantially all the corn moving in interstate commerce, substantially all the corn fed to livestock transported in interstate commerce for fattening, and substantially all the corn fed to livestock marketed in interstate and foreign commerce, is produced in the commercial corn-producing area. Substantially all the corn produced in the commercial corn-producing area, with the exception of a comparatively small amount used for farm consumption, is either sold or transported in interstate commerce, or is fed to livestock transported in interstate commerce for feeding, or is fed to livestock marketed in interstate and foreign commerce. Almost all the corn produced outside the commercial corn-producing area is either consumed, or is fed to livestock which is consumed, in the State in which such corn is produced.

The conditions affecting the production and marketing of corn and the livestock products of corn are such that, without Federal assistance, farmers, individually or in cooperation, cannot effectively prevent the recurrence of disparities between the supplies of livestock moving in interstate and foreign commerce and the supply of corn available for feeding, and provide for orderly marketing of corn in interstate and foreign commerce and livestock and livestock products in interstate and foreign commerce.

The national public interest requires that the burdens on interstate and foreign commerce above described be removed by the exercise of Federal power. By reason of the administrative and physical impracticability of regulating the movement of livestock and livestock products in interstate and foreign commerce and the inadequacy of any such regulation to remove such burdens, such power can be feasibly exercised only by providing for the withholding from market of excessive and burdensome supplies of corn in times of excessive production, and providing a reserve supply of corn available for market in times of deficient production, in order that a stable and continuous flow of livestock and livestock products in interstate and foreign commerce may at all times be assured and maintained. (7 U. S. C. 1321.)

FARM MARKETING QUOTAS

SEC. 322 to 325, which related to marketing quotas for corn, were repealed by 68 Stat. 902.

ADJUSTMENT OF FARM MARKETING QUOTAS

[SEC. 326 below repealed by 68 Stat. 902 insofar as applicable to corn; (b) and (c) below are still applicable to wheat. See paragraph (6), Public Law 74, 77th Congress, on p. 55.]

SEC. 326. (a) Whenever in any county or other area the Secretary finds that the actual production of corn plus the amount of corn stored under seal in such county or other area is less than the normal production of the marketing percentage of the farm acreage allotments in such county or other area, the Secretary shall terminate farm marketing quotas for corn in such county or other area. (7 U. S. C. 1326 (a).)

(b) Whenever, upon any farm, the actual production of the acreage of corn is less than the normal production of the marketing percentage of the farm acreage allotment, there may be marketed, without penalty, from such farm an amount of corn from the corn stored under seal pursuant to section 324 which, together with the actual production of the then current crop, will equal the normal production of the marketing percentage of the farm acreage allotment. (7 U. S. C. 1326 (b).)

(c) Whenever, in any marketing year, marketing quotas are not in effect with respect to the crop of corn produced in the calendar year in which such marketing year begins, all marketing quotas applicable to previous crops of corn shall be terminated. (7 U. S. C. 1326 (c).)

PROCLAMATION OF COMMERCIAL CORN-PRODUCING AREA

SEC. 327. Not later than February 1 of each calendar year, the Secretary shall ascertain and proclaim the commercial corn-producing area (7 U. S. C. 1327).

ACREAGE ALLOTMENT

SEC. 328. The acreage allotment of corn for any calendar year shall be that acreage in the commercial corn-producing area which, on the basis of the average yield for corn in such area during the five calendar years immediately preceding such calendar year, adjusted for abnormal weather conditions, will produce an amount of corn in such area which the Secretary determines will, together with corn produced in the United States outside the commercial corn-producing area and corn imported, make available a supply for the marketing year beginning in such calendar year, equal to the normal supply. The Secretary shall proclaim such acreage allotment not later than February 1 of the calendar year for which such acreage allotment was determined (7 U. S. C. 1328).

APPORTIONMENT OF ACREAGE ALLOTMENT

SEC. 329. (a) The acreage allotment for corn shall be apportioned by the Secretary among the counties in the commercial corn-producing area on the basis of the acreage seeded for the production of corn during the five calendar years immediately preceding the calendar year in which the apportionment is determined (plus, in applicable years, the acreage diverted under previous agricultural adjustment and conservation programs), with adjustments for abnormal weather conditions and for trends in acreage during such period and for the promotion of soil-conservation practices: *Provided*, That any downward adjustment for the promotion of soil-conservation practices

shall not exceed 2 per centum of the total acreage allotment that would otherwise be made to such county. (7 U. S. C. 1329 (a).)

(b) The acreage allotment to the county for corn shall be apportioned by the Secretary, through the local committees, among the farms within the county on the basis of tillable acreage, crop-rotation practices, type of soil, and topography. (7 U. S. C. 1329 (b).)

Sec. 330. Notwithstanding any other provision of law, acreage allotments and a commercial corn-producing area shall not be established for the 1959 and subsequent crops of corn.[12] (7 U. S. C. 1330.)

PART III—MARKETING QUOTAS—WHEAT

LEGISLATIVE FINDINGS

SEC. 331. Wheat is a basic source of food for the Nation, is produced throughout the United States by more than a million farmers, is sold on the country-wide market and, as wheat or flour, flows almost entirely through instrumentalities of interstate and foreign commerce from producers to consumers.

Abnormally excessive and abnormally deficient supplies of wheat on the country-wide market acutely and directly affect, burden, and obstruct interstate and foreign commerce. Abnormally excessive supplies overtax the facilities of interstate and foreign transportation, congest terminal markets and milling centers in the flow of wheat from producers to consumers, depress the price of wheat in interstate and foreign commerce, and otherwise disrupt the orderly marketing of such commodity in such commerce. Abnormally deficient supplies result in an adequate flow of wheat and its products in interstate and foreign commerce with consequent injurious effects to the instrumentalities of such commerce and with excessive increases in the prices of wheat and its products in interstate and foreign commerce.

It is in the interest of the general welfare that interstate and foreign commerce in wheat and its products be protected from such burdensome surpluses and distressing shortages, and that a supply of wheat be maintained which is adequate to meet domestic consumption and export requirements in years of drought, flood, and other adverse conditions as well as in years of plenty, and that the soil resources of the Nation be not wasted in the production of such burdensome surpluses. Such surpluses result in disastrously low prices of wheat and other grains to wheat producers, destroy the purchasing power of grain producers for industrial products, and reduce the value of the agricultural assets supporting the national credit structure. Such shortages of wheat result in unreasonably high prices of flour and bread to consumers and loss of market outlets by wheat producers.

The conditions affecting the production and marketing of wheat are such that, without Federal assistance, farmers, individually or in cooperation, cannot effectively prevent the recurrence of such surpluses and shortages and the burdens on interstate and foreign commerce resulting therefrom, maintain normal supplies of wheat, or

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[12] This section is effective since farmers voting in a referendum which was held on November 25, 1958, voted in favor of no allotments and a price support program as outlined in section 104, Agricultural Act of 1949, as amended (see p. 124).

provide for the orderly marketing thereof in interstate and foreign commerce.

The provisions of this Part affording a cooperative plan to wheat producers are necessary in order to minimize recurring surpluses and shortages of wheat in interstate and foreign commerce, to provide for the maintenance of adequate reserve supplies thereof, and provide for an adequate flow of wheat and its products in interstate and foreign commerce. The provisions hereof for regulation of marketings by producers of wheat whenever an abnormally excessive supply of such commodity exists are necessary in order to maintain an orderly flow of wheat in interstate and foreign commerce under such conditions. (7 U. S. C. 1331.)

PROCLAMATIONS OF SUPPLIES AND ALLOTMENTS

SEC. 332. Not later than May 15 of each calendar year the Secretary shall ascertain and proclaim the national acreage allotment for the crop of wheat produced in the next succeeding calendar year. (7 U. S. C. 1332.)

NATIONAL ACREAGE ALLOTMENT

SEC. 333. The national acreage allotment for any crop of wheat shall be that acreage which the Secretary determines will, on the basis of the national average yield for wheat, produce an amount thereof adequate, together with the estimated carry-over at the beginning of the market year for such crop and imports, to make available a supply for such marketing year equal to a normal year's domestic consumption and exports plus 30 per centum thereof. The national acreage allotment for wheat for any year shall be not less than fifty-five million acres. (7 U. S. C. 1333.)

[Act of July 14, 1953. * * * SEC. 4. Notwithstanding any other provision of law (a) the national acreage allotment for the 1954 crop of wheat shall not be less than sixty-two million acres; and (b) the referendum with respect to the 1954 crop of wheat may be held as late as August 15, 1953. (7 U. S. C. 1334, 1336 notes).]

APPORTIONMENT OF NATIONAL ACREAGE ALLOTMENT

SEC. 334. (a) The national acreage allotment for wheat, less a reserve of not to exceed one per centum thereof for apportionment as provided in this subsection, shall be apportioned by the Secretary among the several States on the basis of the acreage seeded for the production of wheat during the ten calendar years immediately preceding the calendar year in which the national acreage allotment is determined (plus, in applicable years, the acreage diverted under previous agricultural adjustment and conservation programs), with adjustments for abnormal weather conditions and for trends in acreage during such period: *Provided, That in establishing State acreage allotments the acreage seeded for the production of wheat plus the acreage diverted for 1959 and any subsequent year for any farm on which the entire amount of the farm marketing excess is delivered to the Secretary or stored in accordance with applicable regulations to avoid or postpone payment of the penalty shall be the base acreage of*

wheat determined for the farm under the regulations issued by the Secretary for determining farm wheat acreage allotments for such year, but if any part of the amount of wheat so stored is later depleted and penalty becomes due by reason of such depletion, for the purpose of establishing State wheat acreage allotments subsequent to such depletion the seeded plus diverted acreage of wheat for the farm for the year in which the excess was produced shall be reduced to the farm wheat acreage allotment for such year.[13] The reserve acreage set aside herein for apportionment by the Secretary shall be used to make allotments to counties, in addition to the county allotments made under subsection (b) of this section, on the basis of the relative needs of counties for additional allotment because of reclamation and other new areas coming into the production of wheat during the ten calendar years ending with the calendar year in which the national acreage allotment is proclaimed. (7 U. S. C. 1334 (a).)

(b) The State acreage allotment for wheat, less a reserve of not to exceed 3 per centum thereof for apportionment as provided in subsection (c) of this section, shall be apportioned by the Secretary among the counties in the State, on the basis of the acreage seeded for the production of wheat during the ten calendar years immediately preceding the calendar year in which the national acreage allotment is determined (plus, in applicable years, the acreage diverted under previous agricultural adjustment and conservation programs), with adjustments for abnormal weather conditions and trends in acreage during such period and for the promotion of soil-conservation practice: *Provided, That in establishing county acreage allotments the acreage seeded for the production of wheat plus the acreage diverted for 1959 and any subsequent year for any farm on which the entire amount of the farm marketing excess is delivered to the Secretary or stored in accordance with applicable regulations to avoid or postpone payment of the penalty shall be the base acreage of wheat determined for the farm under the regulations issued by the Secretary for determining farm wheat acreage allotments for such year, but if any part of the amount of wheat so stored is later depleted and penalty becomes due by reason of such depletion, for the purpose of establishing county acreage allotments subsequent to such depletion the seeded plus diverted acreage of wheat for the farm for the year in which the excess was produced shall be reduced to the farm wheat acreage allotment for such year.*[14] (7 U. S. C. 1334 (b).)

(c) The allotment to the county shall be apportioned by the Secretary, through the local committees, among the farms within the county on the basis of past acreage of wheat, tillable acres, crop-rotation practices, type of soil, and topography. Not more than 3 per centum of the State allotment shall be apportioned to farms on which wheat has not been planted during any of the three marketing years immediately preceding the marketing year in which the allotment is made. *For the purpose of establishing farm acreage allotments—(i) the past acreage of wheat on any farm for 1958 shall be the base acreage determined for the farm under the regulations issued by the Secre-*

[13] Material in italics enacted by Pub. L. 85–366, 72 Stat. 78, April 4, 1958.

tary for determining 1958 farm wheat acreage allotments; (ii) if subsequent to the determination of such base acreage the 1958 wheat acreage allotment for the farm is increased through administrative, review, or court proceedings, the 1958 farm base acreage shall be increased in the same proportion; and (iii) the past acreage of wheat for 1959 and any subsequent year shall be the wheat acreage on the farm which is not in excess of the farm wheat acreage allotment, plus, in the case of any farm which is in compliance with its farm wheat acreage allotment, the acreage diverted under such wheat allotment programs: Provided, That for 1959 and subsequent years in the case of any farm on which the entire amount of the farm marketing excess is delivered to the Secretary or stored in accordance with applicable regulations to avoid or postpone payment of the penalty, the past acreage of wheat for the year in which such farm marketing excess is so delivered or stored shall be the farm base acreage of wheat determined for the farm under the regulations issued by the Secretary for determining farm wheat acreage allotments for such year, but if any part of the amount of wheat so stored is later depleted and penalty becomes due by reason of such depletion, for the purpose of establishing farm wheat acreage allotments subsequent to such depletion the past acreage of wheat for the farm for the year in which the excess was produced shall be reduced to the farm wheat acreage allotment for such year.[14] (7 U. S. C. 1334 (c).)

[ACT OF FERBUARY 28, 1945.—* * * in establishing acreage allotments under subtitle B of title III of the Agricultural Adjustment Act of 1938, as amended, or under the Soil Conservation and Domestic Allotment Act, as amended, the Secretary of Agriculture, under regulations prescribed by him, may provide that for any crop year (beginning with the crop year 1945) during the present emergency [terminated July 25, 1947, 61 Stat. 451] any farm, with respect to which a cotton, wheat or peanut allotment was established for the 1942 crop, shall be regarded as a farm on which cotton, wheat, or peanuts, as the case may be, were planted and grown, if the Secretary determines that, with respect to cotton or wheat, because of the production of war crops designated by him on such farm, or, with respect to cotton, wheat, or peanuts, because the owner or operator was serving in the armed forces of the United States, the cotton, wheat, or peanut production history of the farm for such year is not representative of the normal history of the farm.

The Secretary may also provide with respect to any such farm that the past acreage of peanuts shall be adjusted upward to the extent that the acreage used for growing peanuts on such farm in such year is below the normal history of the farm (59 Stat. 9, 7 U. S. C. 1334 note).]

(d) Repealed by Public Law 85–835, 72 Stat. 988, August 28, 1958.[15]

(e) Notwithstanding any other provision of this Act, the Secretary shall increase the farm marketing quotas and acreage allotments for the 1957 crop of wheat for farms located in counties in the States of North Dakota, Minnesota, Montana, South Dakota, and California, designated by the Secretary as counties which (1) are capable of pro-

[14] Material in italics enacted by Pub. L. 85–366, 72 Stat. 79, April 4, 1958.
[15] See p. 87 for section 378 enacted to replace this section.

ducing durum wheat (class II) and (2) have produced such wheat for commercial food products during one or more of the five years 1952 through 1956. The increase in the wheat acreage allotment for any farm shall be conditioned upon the production of durum wheat (class II) on such increased acreage. The increased allotment shall be determined by adding to the allotment established without regard to this subsection (hereinafter referred to as the 'original allotment') an acreage equal to the acreage by which the original allotment exceeds the 1957 acreage on the farm of classes of wheat other than durum wheat (class II) (hereinafter referred to as 'other wheat'), but such increased allotment shall not exceed the smaller of the cropland on the farm well suited to wheat or the wheat acreage on the farm: Provided, That for the purposes of this subsection (1) the original allotment for each farm shall be not less than fifteen acres, and (2) varieties of class II (durum wheat) known as 'Golden Ball' and 'Peliss' shall be regarded as 'other wheat'. Notwithstanding any other provision of this subsection, (1) no acreage allotment shall be increased under this subsection by more than sixty acres, and (2) no acreage allotment shall be increased under this subsection for any farm on which the producer knowingly devotes to the production of other wheat an acreage in excess of the acreage allotment established without regard to this subsection (and particularly without regard to clause (1) of the foregoing proviso).

The increases in wheat acreage allotments authorized by this subsection shall be in addition to the National, State, and county wheat acreage allotments, and the acreage of durum wheat (class II) on such increased allotments shall not be considered in establishing future State, county and farm acreage allotments.

The provisions of paragraph (6) of Public Law 74, Seventy-seventh Congress (7 U. S. C. 1340 (6)), and section 326 (b) of this Act, relating to the reduction of the storage amount of wheat shall apply to the allotment for the farm established without regard to this subsection and not to the increased allotment under this subsection.

For the purpose of applying section 103 (a) (1) of the Soil Bank Act (relating to participation in the acreage reserve) to any farm receiving an increased allotment under this subsection—

(1) the 'farm acreage allotment' shall be the allotment established without regard to this subsection and not the increased allotment under this subsection, and

(2) each acre planted to durum wheat (class II) shall count as one-half acre of wheat.

For the purposes of this subsection 'wheat acreage on the farm shall include acreage in the wheat acreage reserve.[16] (7 U. S. C. 1334 (e).)

(f) Any part of any 1955, 1956, or 1957 farm wheat acreage allotment on which wheat will not be planted and which is voluntarily surrendered to the county committee shall be deducted from the allotment to such farm and may be reapportioned by the county committee to other farms in the same county receiving allotments in amounts determined by the county committee to be fair and reasonable on the basis of past acreage of wheat tillable acres, crop rotation practices,

[16] Material in italics added by Pub. L. 85–13, 71 Stat. 10, April 2, 1957.

type of soil, and topography. If all of the allotted acreage voluntarily surrendered is not needed in the county, the county committee may surrender the excess acreage to the State committee to be used for the same purposes as the State acreage reserve under subsection (c) of this section. Any allotment transferred under this provision shall be regarded for the purposes of subsection (c) of this section as having been planted on the farm from which transferred rather than on the farm to which transferred, except that this shall not operate to make the farm from which the allotment was transferred eligible for an allotment as having wheat planted thereon during the three-year base period: *Provided*, That notwithstanding any other provisions of law, any part of any 1955, 1956, or 1957 farm acreage allotment may be permanently released in writing to the county committee by the owner and operator of the farm, and reapportioned as provided herein. Acreage surrendered, reapportioned under this subsection, and planted shall be credited to the State and county in determining future acreage allotments. (7 U. S. C. 1334 (f).)

(g) If the county committee determines that any producer is prevented from seeding wheat for harvest as grain in his usual planting season because of unfavorable weather conditions, and the operator of the farm notifies the county committee not later than December 1 in any area where only winter wheat is grown, or June 1 in the spring wheat area (including an area where both spring and winter wheat are grown), that he does not intend to seed his full wheat allotment for the crop year because of the unfavorable weather conditions, the entire farm wheat allotment for such year shall be regarded as wheat acreage for the purposes of establishing future State, county, and farm acreage allotments: *Provided*, That if any producer on a farm obtains a reduction in the storage amount of any previous crop of wheat by reason of underplanting the farm wheat acreage allotment pursuant to paragraph (6) of Public Law 74, Seventy-seventh Congress (7 U. S. C. 1340 (6), or by reason of producing less than the normal production of the farm wheat acreage allotment pursuant to section 326 (b) of this Act, this provision may not be made applicable to such farm with respect to the crop of wheat for which the farm acreage allotment was established. (7 U. S. C. 1334 (g).)

(h) Notwithstanding any other provision of law, no acreage in the commercial wheat-producing area seeded to wheat for harvest as grain in 1958 or thereafter in excess of acreage allotments shall be considered in establishing future State and county acreage allotments except as prescribed in the provisos to the first sentence of subsections (a) and (b), respectively, of this section. The planting on a farm in the commercial wheat-producing area of wheat of the 1958 or any subsequent crop for which no farm wheat acreage allotment was established shall not make the farm eligible for an allotment as an old farm pursuant to the first sentence of subsection (c) of this section nor shall such farm by reason of such planting be considered ineligible for an allotment as a new farm under the second sentence of such subsection.[17] (7 U. S. C. 1334 (h).)

[17] Material in italics enacted by Pub. L. 85–203, 71 Stat. 477, August 28, 1957.

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(i) Notwithstanding any other provision of this Act the Secretary shall increase the acreage allotments for the 1958 and 1959 crops of wheat for farms in the irrigable portion of the area known as the Tulelake division of the Klamath project of California located in Modoc and Siskiyou Counties, California, as defined by the United States Department of Interior, Bureau of Reclamation, and hereinafter referred to as the area. The increase for the area for each such crop shall be determined by adding to the total allotments established for farms in the area for the particular crop without regard to this subsection, hereinafter referred to as the original allotments, an acreage sufficient to make available for each such crop a total allotment of eight thousand acres for the area. The additional allotments made available by this subsection shall be in addition to the National, State and county allotments otherwise established under this Act, but the acreage planted to wheat pursuant to such increased allotments shall be taken into account in establishing future State, county, and farm acreage allotments. The Secretary shall apportion the additional allotment acreage made available under this subsection between Modoc and Siskiyou Counties on the basis of the relative needs for additional allotments for the portion of the area in each county. The Secretary shall also allot such additional acreage to individual farms in the area for which an application for an increased acreage is made on the basis of tillable acres, crop rotation practices, type of soil and topography, and taking into account the original allotment for the farm, if any. No producer shall be eligible to participate in the wheat acreage reserve program with respect to any farm for any year for which such farm receives an additional allotment under this subsection; and no wheat produced on such farm in such year shall be eligible for price support. The increase in the wheat acreage allotment for any farm under this subsection shall be conditioned upon the production of durum wheat (class II) on such increased acreage.[18] (7 U. S. C. 1334 (i).)

[AGRICULTURAL ACT OF 1954.—SEC. 314 * * * Notwithstanding any other provision of law, in areas where a summer fallow crop rotation of wheat is a common practice the 1955 wheat acreage allotment for any farm on which such rotation was practiced with respect to the 1952 and 1953 crops of wheat shall not be less than 50 per centum of (1) the average acreage planted for the production of wheat for the calendar years 1952 and 1953 plus (2) the average of the acreage summer fallowed during the calendar year 1951 for the seeding of wheat for 1952 and the acreage summer fallowed during the calendar year of 1952 for the seeding of wheat for 1953, adjusted in the same ratio as the national average seedings for the production of wheat during the calendar years 1952 and 1953 bears to the national acreage allotment for wheat for the 1955 crop, taking into consideration the adjustments made for crop rotation practices pursuant to the regulations pertaining to farm acreage allotments for the 1955 crop of wheat issued by the Secretary: *Provided*, That, except for farms on which at least 90 per centum of the acreage seeded for the production of wheat for the calendar years 1952 and 1953 was seeded on land which was summer fallowed during the years 1951 and 1952, respectively,

[18] New subsection added by Pub. L. 85–390, 72 Stat. 101, May 1, 1958.

and for which a definite and regular alternate wheat and summer fallow crop rotation practice has been determined under the aforesaid regulations, the acreage determined under this section to which the national adjustment factor is applied shall not exceed 50 per centum of the cropland on the farm well suited for the production of wheat: *Provided further*, That no acreage shall be included under (1) or (2) which the Secretary, by appropriate regulations, determines will become an undue erosion hazard under continued farming: *Provided further*, That the acreage determined under this section to which the national adjustment factor is applied shall not exceed six hundred and forty acres, with the acres in excess of six hundred and forty acres, if any, to be adjusted by the adjustment factor for the county. To the extent that the allotment to any county is insufficient to provide for such minimum farm allotments, the Secretary shall allot such county such additional acreage (which shall be in addition to the county, State, and National acreage allotments otherwise provided for under the Agricultural Adjustment Act of 1938, as amended) as may be necessary in order to provide for such minimum farm allotments. (7 U. S. C. 1334a)]

MARKETING QUOTAS

SEC. 335. (a) Whenever in any calendar year the Secretary determines—

(1) that the total supply of wheat for the marketing year beginning in such calendar year will exceed the normal supply for such marketing year by more than 20 per centum; or

(2) that the total supply of wheat for the marketing year ending in such calendar year is not less than the normal supply for the marketing year so ending, and that the average farm price for wheat for three successive months of the marketing year so ending does not exceed 66 per centum of parity

the Secretary shall, not later than May 15 of such calendar year, proclaim such fact and, during the marketing year beginning July 1 of the next succeeding calendar year and continuing throughout such marketing year, a national marketing quota shall be in effect with respect to the marketing of wheat. Marketing quotas for any marketing year shall be in effect with respect to wheat harvested in the calendar year in which such marketing year begins notwithstanding that the wheat is marketed prior to the beginning of such marketing year. (7 U. S. C. 1335 (a).)

(b) The amount of the national marketing quota for wheat shall be equal to a normal year's domestic consumption and exports plus 30 per centum thereof, less the sum of (1) the estimated carry-over of wheat as of the beginning of the marketing year with respect to which the quota is proclaimed and (2) the estimated amount of wheat which will be used on farms as seed or livestock feed during the marketing year. (7 U. S. C. 1335 (b).)

(c) The farm marketing quota for any farm for any marketing year shall be a number of bushels of wheat equal to the sum of—

(1) A number of bushels equal to the normal production or the actual production, whichever is the greater, of the farm acreage allotment; and

(2) A number of bushels equal to the amount, or part thereof, of wheat from any previous crop which the farmer has on hand which, had such amount, or part thereof, been marketed during the preceding marketing year in addition to the wheat actually marketed during such preceding marketing year, could have been marketed without penalty.

(3) Any farmer who does not market wheat in excess of the normal production or the actual production, whichever is the greater, of the farm acreage allotment shall not be subject to penalty under the provisions of section 339. Any farmer who stores, in accordance with regulations issued by the Secretary, an amount of wheat which is less than the amount subject to penalty, shall be presumed to have marketed the amount of such wheat subject to penalty which is not so stored. (7 U. S. C. 1335 (c).)

[ACT OF MAY 26, 1941.[19]— * * * notwithstanding the provisions of the Agricultural Adjustment Act of 1938, as amended (hereinafter referred to as the Act)—

(1) The farm marketing quota under the Act for any crop of wheat shall be the actual production of the acreage planted to wheat on the farm, less the normal production or the actual production, whichever is the smaller, of that acreage planted to wheat on the farm which is in excess of the farm acreage allotment for wheat. The farm marketing quota under the Act for any crop of corn shall be the actual production of the acreage planted to corn on the farm, less the normal production or the actual production, whichever is the smaller, of that acreage planted to corn on the farm which is in excess of the farm acreage allotment for corn.

The normal production, or the actual production, whichever is the smaller, of such excess acreage is hereinafter called the "farm marketing excess" of corn or wheat, as the case may be. For the purposes of this resolution, "actual production" of any number of acres of corn or wheat on a farm means the actual average yield of corn or wheat, as the case may be, for the farm times such number of acres.

(2) During any marketing year for which quotas are in effect, the producer shall be subject to a penalty on the farm marketing excess of corn and wheat. The rate of the penalty on wheat shall be 45 per centum of the parity price per bushel of wheat as of May 1 of the calendar year in which the crop is harvested.

(3) The farm marketing excess for corn and wheat shall be regarded as available for marketing, and the penalty and the storage amount or amounts to be delivered to the Secretary of the commodity shall be computed upon the normal production of the excess acreage. Where, upon the application of the producer for an adjustment of penalty or of storage, it is shown to the satisfaction of the Secretary that the actual production of the excess acreage is less than the normal production thereof,

[19] Sec. 313 of Agriculture Act of 1954 provides that this law shall no longer be applicable to corn.

the difference between the amount of the penalty or storage as computed upon the basis of normal production and as computed upon the basis of actual production shall be returned to or allowed the producer. The Secretary shall issue regulations under which the farm marketing excess of the commodity for the farm may be stored or delivered to him. Upon failure to store or deliver to the Secretary the farm marketing excess within such time as may be determined under regulations prescribed by the Secretary, the penalty computed as aforesaid shall be paid by the producer. Any corn or wheat delivered to the Secretary hereunder shall become the property of the United States and shall be disposed of by the Secretary for relief purposes in the United States or in foreign countries or in such other manner as he shall determine will divert it from the normal channels of trade and commerce.

(4) Until the producers on any farm store, deliver to the Secretary, or pay the penalty on, the farm marketing excess of any crop of corn or wheat, the entire crop of corn or wheat, as the case may be, produced on the farm shall be subject to a lien in favor of the United States for the amount of the penalty.

(5) The penalty upon corn or wheat stored shall be paid by the producer at the time, and to the extent, of any depletion in the amount of the commodity so stored, except depletion resulting from some cause beyond the control of the producer.

(6) Whenever the planted acreage of the then current crop of corn or wheat on any farm is less than the farm acreage allotment for such commodity, the total amount of the commodity from any previous crops required to be stored in order to postpone or avoid payment of penalty shall be reduced by that amount which is equal to the normal production of the number of acres by which the farm acreage allotment exceeds the planted acreage. The provisions of section 326 (b) and (c) of the Act shall be applicable also to wheat.

(7) A farm marketing quota on corn or wheat shall not be applicable to any farm on which the acreage planted to the commodity is not in excess of fifteen acres. The marketing penalty on corn or wheat shall not be applicable to any farm which, under the terms of the then current agricultural conservation program formulated under sections 7 to 17, inclusive, of the Soil Conservation and Domestic Allotment Act, is classified as a nonallotment farm if the acreage of the commodity harvested on such nonallotment farm is not in excess of fifteen acres or the acreage allotment for the farm, whichever is larger. If the acreage of the commodity harvested on any such nonallotment farm is in excess of fifteen acres and in excess of such acreage allotment, the normal production or the actual production, whichever is the smaller, of the acreage harvested in excess of fifteen acres or such acreage allotment, whichever is larger, shall be taken as the farm marketing excess and shall be subject to penalty: *Provided*, That there shall be no penalty on wheat harvested on any such nonallotment farm from which no wheat is sold if the acreage of wheat harvested on such farm does not exceed such acreage per family living thereon as may be used for home consumption

without reducing the payment with respect to the farm under the then current agricultural conservation program: *Provided further*, That for the marketing year beginning in 1941, there shall be no marketing penalty on wheat with respect to any such nonallotment farm if the acreage of wheat harvested on the farm is not in excess of the usual acreage determined for the farm under the 1941 agricultural conservation program and the county committee determines, in accordance with regulations of the Secretary, that there will not be marketed an amount of wheat in excess of the 1941 farm marketing quota.

(8) Until the farm marketing excess of corn or wheat, as the case may be, is stored or delivered to the Secretary or the penalty thereon is paid, each bushel of the commodity produced on the farm which is sold by the producer to any person within the United States shall be subject to the penalty as specified in paragraph (2) of this resolution. Such penalty shall be paid by the buyer, who may deduct an amount equivalent to the penalty from the price paid to the producer.

(9) (Not applicable to wheat.)

(10) (Applicable only through the 1946 crop.)

(11) The provisions of this resolution are amendatory of and supplementary to the Act, and all provisions of law applicable in respect of marketing quotas and loans under such Act as so amended and supplemented shall be applicable, but nothing in this resolution shall be construed to amend or repeal section 301 (b) (6), 323 (b), or 335 (d) of the Act.

(12) Notwithstanding any of the foregoing provisions, the farm marketing excess for any crop of wheat for any farm shall not be larger than the amount by which the actual production of such crop of wheat on the farm exceeds the normal production of the farm wheat-acreage allotment, if the producer establishes such actual production to the satisfaction of the Secretary. Where a downward adjustment in the amount of the farm marketing excess is made pursuant to the provisions of this paragraph, the difference between the amount of the penalty or storage as computed upon the farm marketing excess before such adjustment and as computed upon the adjusted farm marketing excess shall be returned to or allowed the producer. (55 Stat. 203, 7 U. S. C. 1330, 1340.)]

(d) No farm marketing quota with respect to wheat shall be applicable in any marketing year to any farm on which the normal production of the acreage planted to wheat of the current crop is less than two hundred bushels. (7 U. S. C. 1335 (d).)

(e) If, for any marketing year, the acreage allotment for wheat for any State is twenty-five thousand acres or less, the Secretary, in order to promote efficient administration of this Act and the Agricultural Act of 1949, may designate such State as outside the commercial wheat-producing area for such marketing year. No farm marketing quota or acreage allotment with respect to wheat under this title shall be applicable in such marketing year to any farm in any State so designated; and no acreage allotment in any other State shall be increased by reason of such designation. Notice of any such designation shall be published in the Federal Register. (7 U. S. C. 1335 (e).)

(f) The Secretary, upon application made pursuant to regulations prescribed by him, shall exempt producers from any obligation under this Act to pay the penalty on, deliver to the Secretary, or store the farm marketing excess with respect to any farm for any crop of wheat harvested in 1958 or any subsequent year on the following conditions:

(1) That the total wheat acreage on the farm does not exceed 30 acres: Provided, however, That this condition shall not apply to farms operated by and as part of State or county institutions or religious or eleemosynary institutions;

(2) That none of such crop of wheat is removed from such farm except to be processed for use as human food or livestock feed on such farm and none of such crop is sold or exchanged for goods or services;

(3) That such entire crop of wheat is used on such farm for seed, human food, or feed for livestock, including poultry, owned by any such producer, or a subsequent owner or operator of the farm; and

(4) That such producers and their successors comply with all regulations prescribed by the Secretary for the purpose of determining compliance with the foregoing conditions.

Failure to comply with any of the foregoing conditions shall cause the exemption to become immediately null and void unless such failure is due to circumstances beyond the control of such producers as determined by the Secretary. In the event an exemption becomes null and void the provisions of this Act shall become applicable to the same extent as if such exemption had not been granted. No acreage planted to wheat in excess of the farm acreage allotment for a crop covered by an exemption hereunder shall be considered in determining any subsequent wheat acreage allotment or marketing quota for such farm and the estimated production from such excess acreage shall not be included in total supply and normal supply in the determination of future marketing quotas and level of price support. No producer exempted under this section shall be eligible to vote in the referendum under section 336 with respect to the next subsequent crop of wheat.[20]

REFERENDUM

SEC. 336. Between the date of the issuance of any proclamation of any national marketing quota for wheat and July 25,[21] the Secretary shall conduct a referendum, by secret ballot, of farmers who will be subject to the quota specified therein to determine whether such farmers favor or oppose such quota. If more than one-third of the farmers voting in the referendum oppose such quota, the Secretary shall, proir to the effective date of such quota, by proclamation suspend the operation of the national marketing quotas with respect to wheat. (7 U. S. C. 1336.)

ADJUSTMENT AND SUSPENSION OF QUOTA

SEC. 337. (a) If the total supply as proclaimed by the Secretary within forty-five days after the beginning of the marketing year is less

[20] New subsection added by Pub. L. 85–203, 71 Stat. 477, August 28, 1957.

[21] The last date for holding the referendum on the 1954 crop was extended to August 15, 1953, by sec. 4 of the Act of July 14, 1953.

than that specified in the proclamation by the Secretary under section 335 (a), then the national marketing quota specified in the proclamation under such section shall be increased accordingly. (7 U. S. C. 1337 (a).)

(b) Whenever it shall appear from either the July or the August production estimates, officially published by the Division of Crop and Livestock Estimates of the Bureau of Agricultural Economics of the Department, that the total supply of wheat as of the beginning of the marketing year was less than a normal year's domestic consumption and exports plus 30 per centum thereof, the Secretary shall proclaim such fact prior to July 20, or August 20, as the case may be, if farm marketing quotas have been announced with respect to the crop grown in such calendar year. Thereupon such quotas shall become ineffective. (7 U. S. C. 1337 (b).)

TRANSFER OF QUOTAS

SEC. 338. Farm marketing quotas for wheat shall not be transferable, but, in accordance with regulations prescribed by the Secretary for such purpose, any farm marketing quota in excess of the supply of wheat for such farm for any marketing year may be allocated to other farms on which the acreage allotment has not been exceeded. (7 U. S. C. 1338.)

PENALTIES

SEC. 339. (Repealed by 67 Stat. 151)[22]

PART IV—MARKETING QUOTAS—COTTON

LEGISLATIVE FINDINGS

SEC. 341. American cotton is a basic source of clothing and industrial products used by every person in the United States and by substantial numbers of people in foreign countries. American cotton is sold on a world-wide market and moves from the places of production almost entirely in interstate and foregin commerce to processing establishments located throughout the world at places outside the State where the cotton is produced.

Fluctuations in supplies of cotton and the marketing of excessive supplies of cotton in interstate and foreign commerce disrupt the orderly marketing of cotton in such commerce with consequent injury to and destruction of such commerce. Excessive supplies of cotton directly and materially affect the volume of cotton moving in interstate and foreign commerce and cause disparity in prices of cotton and industrial products moving in interstate and foreign commerce with consequent diminution of the volume of such commerce in industrial products.

The conditions affecting the production and marketing of cotton are such that, without Federal assistance, farmers, individually or in cooperation, cannot effectively prevent the recurrence of excessive supplies of cotton and fluctuations in supplies, cannot prevent indis-

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[22] For penalty provision see Act of May 26, 1941, p. 54.

criminate dumping of excessive supplies on the Nation-wide and foreign markets, cannot maintain normal carry-overs of cotton, and cannot provide for the orderly marketing of cotton in interstate and foreign commerce.

It is in the interest of the general welfare that interstate and foreign commerce in cotton be protected from the burdens caused by the marketing of excessive supplies of cotton in such commerce, that a supply of cotton be maintained which is adequate to meet domestic consumption and export requirements in years of drought, flood and other adverse conditions as well as in years of plenty, and that the soil resources of the Nation be not wasted in the production of excessive supplies of cotton.

The provisions of this Part affording a cooperative plan to cotton producers are necessary and appropriate to prevent the burdens on interstate and foreign commerce caused by the marketing in such commerce of excessive supplies, and to promote, foster, and maintain an orderly flow of an adequate supply of cotton in such commerce. (7 U. S. C. 1341.)

NATIONAL MARKETING QUOTA

SEC. 342. Whenever during any calendar year the Secretary determines that the total supply of cotton for the marketing year beginning in such calendar year will exceed the normal supply for such marketing year, the Secretary shall proclaim such fact and a national marketing quota shall be in effect for the crop of cotton produced in the next calendar year. The Secretary shall also determine and specify in such proclamation the amount of the national marketing quota in terms of the number of bales of cotton (standard bales of five hundred pounds gross weight) adequate, together with (1) the estimated carry-over at the beginning of the marketing year which begins in the next calender year and (2) the estimated imports during such marketing year, to make available a normal supply of cotton: *Provided, That beginning with the 1961 crop, the national marketing quota shall be not less than a number of bales equal to the estimated domestic consumption and estimated exports (less estimated imports) for the marketing year for which the quota is proclaimed, except that the Secretary shall make such adjustment in the amount of such quota as he determines necessary after taking into consideration the estimated stocks of cotton in the United States (including the qualities of such stocks) and stocks in foreign countries which would be available for the marketing year for which the quota is being proclaimed if no adjustment of such quota is made hereunder, to assure the maintenance of adequate but not excessive stocks in the United States to provide a continuous and stable supply of the different qualities of cotton needed in the United States and in foreign cotton consuming countries, and for purposes of national security; but the Secretary, in making such adjustments, may not reduce the national marketing quota for any year below (i) one million bales less than the estimated domestic consumption and estimated exports for the marketing year for which such quota is being proclaimed, or (ii) ten million bales, whichever is larger.*[23] Such proclamation shall be made not later than October

[23] Material in italics enacted by Pub. L. 85–835, 72 Stat. 989, August 28, 1958.

15 of the calendar year in which such determination is made. Notwithstanding the foregoing provisions of this section, the national marketing quota for cotton for 1957 and 1958 shall be not less than the number of bales required to provide a national acreage allotment for 1957 and 1958 equal to the national acreage allotment for 1956: *Provided*, That if the acreage allotment for any State for 1957 or 1958 is less than its allotment for the preceding year by more than 1 per centum, such State allotment shall be increased so that the reduction shall not exceed 1 per centum per annum, and the acreage required for such increase shall be in addition to the national acreage allotment for such year. Additional acreage apportioned to a State for 1957 or 1958 under the foregoing proviso shall not be taken into account in establishing future State allotments. *Notwithstanding any other provision of this Act, the national marketing quota for upland cotton for 1959 and subsequent years shall be not less than the number of bales required to provide a national acreage allotment for each such year of sixteen million acres.*[23] (7 U. S. C. 1342.)

REFERENDUM

SEC. 343. Not later than December 15 following the issuance of the marketing quota proclamation provided for in section 342, the Secretary shall conduct a referendum, by secret ballot, of farmers engaged in the production of cotton in the calendar year in which the referendum is held, to determine whether such farmers are in favor of or opposed to the quota so proclaimed: *Provided*, That if marketing quotas are proclaimed for the 1950 crop, farmers eligible to vote in the referendum held with respect to such crop shall be those farmers who were engaged in the production of cotton in the calendar year of 1948. If more than one-third of the farmers voting in the referendum oppose the national marketing quota, such quota shall become ineffective upon proclamation of the results of the referendum. The Secretary shall proclaim the results of any referendum held hereunder within thirty days after the date of such referendum. (7 U. S. C. 1343.)

ACREAGE ALLOTMENTS

SEC. 344. (a) Whenever a national marketing quota is proclaimed under section 342, the Secretary shall determine and proclaim a national acreage allotment for the crop of cotton to be produced in the next calendar year. The national acreage allotment for cotton shall be that acreage, based upon the national average yield per acre of cotton for the *four*[24] years immediately preceding the calendar year in which the national marketing quota is proclaimed, required to make available from such crop an amount of cotton equal to the national marketing quota. (7 U. S. C. 1344 (a).)

(b) The national acreage allotment for cotton for 1953 and subsequent years shall be apportioned to the States on the basis of the acreage planted to cotton (including the acreage regarded as having been planted to cotton under the provisions of Public Law 12, Seventy-ninth Congress) during the five calendar years immediately preceding

[24] The word "four" substituted for "five" by Pub. L. 85–835, 72 Stat. 990, August 28, 1958.

the calendar year in which the national marketing quota is proclaimed, with adjustments for abnormal weather conditions during such period: *Provided*, That there is hereby established a national acreage reserve consisting of one hundred thousand acres which shall be in addition to the national acreage allotment; and such reserve shall be apportioned to the States on the basis of their needs for additional acreage for establishing minimum farm allotments under subsection (f) (1), as determined by the Secretary without regard to State and county acreage reserves (except that the amount apportioned to Nevada shall be one thousand acres), and the additional acreage so apportioned to the State shall be apportioned to the counties on the same basis and added to the county acreage allotment for apportionment to farms pursuant to subsection (f) of this section (except that no part of such additional acreage shall be used to increase the county reserve above 15 per centum of the county allotment determined without regard to such additional acreage). Additional acreage apportioned to a State for any year under the foregoing proviso shall not be taken into account in establishing future State acreage allotments. Needs for additional acreage under the foregoing proviso and under the last proviso in subsection (e) shall be determined as though allotments were first computed without regard to subsection (f) (1):[25] *Provided, That there is hereby established a national acreage reserve consisting of three hundred and ten thousand acres which shall be in addition to the national acreage allotment; and such reserve shall be apportioned to the States on the basis of their needs for additional acreage for establishing minimum farm allotments under subsection (f) (1), as determined by the Secretary without regard to State and county acreage reserves (except that the amount apportioned to Nevada shall be one thousand acres). For the 1960 and succeeding crops of cotton, the needs of States (other than Nevada) for such additional acreage for such purpose may be estimated by the Secretary, after taking into consideration such needs as determined or estimated for the preceding crop of cotton and the size of the national acreage allotment for such crop. The additional acreage so apportioned to the State shall be apportioned to the counties on the basis of the needs of the counties for such additional acreage for such purpose, and added to the county acreage allotment for apportionment to farms pursuant to subsection (f) of this section (except that no part of such additional acreage shall be used to increase the county reserve above 15 per centum of the county allotment determined without regard to such additional acreage). Additional acreage apportioned to a State for any year under the foregoing proviso shall not be taken into account in establishing future State acreage allotments. Needs for additional acreage under the foregoing provisions and under the last proviso in subsection (e) shall be determined or estimated as though allotments were first computed without regard to subsection (f) (1).*[26] [The portion in italics is effective beginning with the 1959 crop.] (7 U. S. C. 1344 (b).)

(c) Applicable only to the 1950 and 1951 crops of cotton.)

(d) (Applicable only to the 1952 crop of cotton.)

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[25] Material starting with the word "Provided" and ending with "subsection (f) (1):" is effective only with respect to the 1957 and 1958 crop of cotton.

[26] New proviso added by Pub. L. 85–835, 72 Stat. 990, August 28, 1958.

(e) The State acreage allotment for cotton shall be apportioned to counties on the same basis as to years and conditions as is applicable to the State under subsections (b), (c), and (d) of this section: *Provided*, That the State committee may reserve not to exceed 10 per centum of its State acreage allotment (15 per centum if the State's 1948 planted acreage was in excess of one million acres and less than half its 1943 allotment) which shall be used to make adjustments in county allotments for trends in acreage, for counties adversely affected by abnormal conditions affecting plantings, or for small or new farms, or to correct inequities in farm allotments and to prevent hardship:[27] *Provided further*, That if the additional acreage allocated to a State under the proviso in subsection (b) is less than the requirements as determined by the Secretary for establishing minimum farm allotments for the State under subsection (f) (1), the acreage reserved by the State committee under this subsection shall not be less than the smaller of (1) the remaining acreage so determined to be required for establishing minimum farm allotments or (2) 3 per centum of the State acreage allotment; and the acreage which the State committee is required to reserve under this proviso shall be allocated to counties on the basis of their needs for additional acreage for establishing minimum farm allotments under subsection (f) (1), and added to the county acreage allotment for apportionment to farms pursuant to subsection (f) of this section (except that no part of such additional acreage shall be used to increase the county reserve above 15 per centum of the county allotment determined without regard to such additional acreages).[28] *Provided further, That if the additional acreage allocated to a State under the proviso in subsection (b) is less than the requirements as determined or estimated by the Secretary for establishing minimum farm allotments for the State under subsection (f) (1), the acreage reserved under this subsection shall not be less than the smaller of (1) the remaining acreage so determined or estimated to be required for establishing minimum farm allotments or (2) 3 per centum of the State acreage allotment; and the acreage which is required to be reserved under this proviso shall be allocated to counties on the basis of their needs for additional acreage for establishing minimum farm allotments under subsection (f) (1), and added to the county acreage allotment for apportionment to farms pursuant to subsection (f) of this section (except that no part of such additional acreage shall be used to increase the county reserve above 15 per centum of the county allotment determined without regard to such additional acreages).*[29]

[The proviso in italics is effective beginning with the 1959 crop of cotton.] (7 U. S. C. 1344 (e).)

(f) The county acreage allotment, less not to exceed the percentage provided for in paragraph (3) of this subsection, shall be apportioned to farms on which cotton has been planted (or regarded as having been planted under the provisions of Public Law 12, Seventy-ninth

[27] In subsection (e), the words in the first proviso beginning with "or to correct" and ending with "to prevent hardship" have been omitted from the text of section 1344 (e) as it appears in 7 U. S. C. 1344 (e) (1952 Edition, Supplement V).

[28] Second proviso is effective only with respect to the 1957 and 1958 crops of cotton.

[29] The proviso and subparagraph (1) of subsection (f) in italics were added by Pub. L. 85–835, 72 Stat. 991, August 28, 1958.

Congress) in any one of the three years immediately preceding the year for which such allotment is determined on the following basis:

(1) Insofar as such acreage is available, there shall be allotted the smaller of the following: (A) ten acres; or (B) the acreage allotment established for the farm for the 1958 crop.[29]

[This portion in italics is effective beginning with the 1959 crop of cotton.]

(2) The remainder shall be allotted to farms other than farms to which an allotment has been made under paragraph (1) (B) so that the allotment to each farm under this paragraph together with the amount of the allotment to such farm under paragraph (1) (A) shall be a prescribed percentage (which percentage shall be the same for all such farms in the county or administrative area) of the acreage, during the preceding year, on the farm which is tilled annually or in regular rotation, excluding from such acreages the acres devoted to the production of sugarcane for sugar; sugar beets for sugar; wheat, tobacco, or rice for market; peanuts picked and threshed; wheat or rice for feeding to livestock for market; or lands determined to be devoted primarily to orchards or vineyards, and nonirrigated lands in irrigated areas: *Provided*, *however*, That if a farm would be allotted under this paragraph an acreage together with the amount of the allotment to such farm under paragraph (1) (A) in excess of the largest acreage planted (and regarded as planted under Public Law 12, Seventy-ninth Congress) to cotton during any of the preceding three years, the acreage allotment for such farm shall not exceed such largest acreage so planted (and regarded as planted under Public Law 12, Seventy-ninth Congress) in any such year.

(3) The county committee may reserve not in excess of 15 per centum of the county allotment * * * which, in addition to the acreage made available under the proviso in subsection (e), shall be used for (A) establishing allotments for farms on which cotton was not planted (or regarded as planted under Public Law 12, Seventy-ninth Congress) during any of the three calendar years immediately preceding the year for which the allotment is made, on the basis of land, labor, and equipment available for the production of cotton, crop-rotation practices, and the soil and other physical facilities affecting the production of cotton; and (B) making adjustments of the farm acreage allotments established under paragraphs (1) and (2) of this subsection so as to establish allotments which are fair and reasonable in relation to the factors set forth in this paragraph and abnormal conditions of production on such farms, or in making adjustments in farm acreage allotments to correct inequities and to prevent hardships: *Provided*, That not less than 20 per centum of the acreage reserved under this subsection shall, to the extent required, be allotted, upon such basis as the Secretary deems fair and reasonable to farms (other than farms to which an allotment has been made under subsection (f) (1) (B)), if any, to which an allotment of not exceeding fifteen acres may be made under other provisions of this subsection.

(4) (Applicable only to the 1950 crop of cotton)

(5) (Applicable only to the 1950 crop of cotton)

(6) Notwithstanding the provisions of paragraph (2) of the subsection, if the county committee recommends such action and the Secretary determines that such action will result in a more equitable distribution of the county allotment among farms in the county, the remainder of the county acreage allotment (after making allotments as provided in paragraph (1) of this subsection) shall be allotted to farms other than farms to which an allotment has been made under paragraph (1) (B) of this subsection so that the allotment to each farm under this paragraph together with the amount of the allotment of such farm under paragraph (1) (A) of this subsection shall be a prescribed percentage (which percentage shall be the same for all such farms in the county) of the average acreage planted to cotton on the farm during the three years immediately preceding the year for which such allotment is determined, adjusted as may be necessary for abnormal conditions affecting plantings during such three-year period: Provided, That the county committee may in its discretion limit any farm acreage allotment established under the provisions of this paragraph for any year to an acreage not in excess of 50 per centum of the cropland on the farm, as determined pursuant to the provisions of paragraph (2) of this subsection: Provided further, That any part of the county acreage allotment not apportioned under this paragraph by reason of the initial application of such 50 per centum limitation shall be added to the county acreage reserve under paragraph (3) of this subsection and shall be available for the purposes specified therein.[30] [The portion in italics effective beginning with the 1959 crop.] If the county acreage allotment is apportioned among the farms of the county in accordance with the provisions of this paragraph, the acreage reserved under paragraph (3) of this subsection may be used to make adjustments so as to establish allotments which are fair and reasonable to farms receiving allotments under this paragraph in relation to the factors set forth in paragraph (3).

(7) (A) in the event that any farm acreage allotment is less than that prescribed by paragraph (1), such acreage allotment shall be increased to the acreage prescribed by paragraph (1). The additional acreage required to be allotted to farms under this paragraph shall be in addition to the county, State, and national acreage allotments and the production from such acreage shall be in addition to the national marketing quota.

(B) Notwithstanding any other provision of law—

(i) the acreage by which any farm acreage allotment for 1959 or any subsequent crop established under paragraph (1) exceeds the acreage which would have been allotted to such farm if its allotment had been computed on the basis of the same percentage factor applied to other farms in the county under paragraph (2), (6), or (8) shall not be taken into account in establishing the acreage allotment

[30] New material was substituted for paragraph (6), by Pub. L. 85-835, 72 Stat. 991, August 28, 1958.

for such farm for any crop for which acreage is allotted to such farm under paragraph (2), (6), or (8); and acreage shall be allotted under paragraph (2), (6), or (8) to farms which did not receive 1958 crop allotments in excess of ten acres if and only if the Secretary determines (after considering the allotments to other farms in the county for such crop compared with their 1958 allotments and other relevant factors) that equity and justice require the allotment of additional acreage to such farm under paragraph (2), (6), or (8),

(ii) the acreage by which any county acreage allotment for 1959 or any subsequent crop is increased from the national or State reserve on the basis of its needs for additional acreage for establishing minimum farm allotments shall not be taken into account in establishing future county acreage allotments, and

(iii) the additional acreage allotted pursuant to subparagraph (A) of this paragraph (7) shall not be taken into account in establishing future State, county, or farm acreage allotments.[31]

[This new paragraph is effective beginning with the 1959 crop.]

(8) Notwithstanding the foregoing provisions of paragraphs (2) and (6) of this subsection, the Secretary may, if he determines that such action will facilitate the effective administration of the provisions of the Act, provide for the county acreage allotment for the 1959 and succeeding crops of cotton, less the acreage reserved under paragraph (3) of this subsection, to be apportioned to farms on which cotton has been planted in any one of the three years immediately preceding the year for which such allotment is determined, on the basis of the farm acreage allotment for the year immediately preceding the year for which such apportionment is made, adjusted as may be necessary (i) for any change in the acreage of cropland available for the production of cotton, or (ii) to meet the requirements of any provision (other than those contained in paragraphs (2) and (6)) with respect to the counting of acreage for history purposes.[31] (7 U. S. C. 1344 (f).)

[AGRICULTURAL ACT OF 1956. SEC. 303 (e).—For the 1956 crop, an acreage in each State equal to the acreage allotted in such State which the Secretary determines will not be planted, placed in the acreage reserve or conservation reserve, or considered as planted under section 377 of the Agricultural Adjustment Act of 1938, as amended, may be apportioned by the Secretary among farms in such State having allotments of less than the smaller of the following: (1) four acres, or (2) the highest number of acres planted to cotton in any of the years 1953, 1954, and 1955.] (7 U. S. C. 1344 note).

(g) Notwithstanding the foregoing provisions of this section—

(1) State, county, and farm acreage allotments and yields for cotton shall be established in conformity with Public Law 28, Eighty-first Congress.

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[31] New paragraphs 7 and 8 added by Pub. L. 85–835, 72 Stat. 991, 992, August 28, 1958.

(2) In apportioning the county alloment among the farms within the county, the Secretary, through the local committees, shall take into consideration different conditions within separate administrative areas within a county if any exist, including types, kinds, and productivity of the soil so as to prevent discrimination among the administrative areas of the county.

(3) For any farm on which the acreage planted to cotton in any year is less than the farm acreage allotment for such year by not more than the larger of 10 per centum of the allotment or one acre, an acreage equal to the farm acreage allotment shall be deemed to be the acreage planted to cotton on such farm, and the additional acreage added to the cotton acreage history for the farm shall be added to the cotton acreage history for the county and State. (7 U. S. C. 1344 (g).)

[Act of March 29, 1949 * * * notwithstanding the provisions of title III of the Agricultural Adjustment Act of 1938, as amended, or of any other law, State, county, and farm acreage allotments and yields for cotton for any year after 1949 shall be computed without regard to yields or to the acreage planted to cotton in 1949. (7 U. S. C. 1344a)]

(h) Repealed by P. L. 85–835 (72 Stat. 996.), August 28, 1958.[32]

(i) Notwithstanding any other provision of this Act, any acreage planted to cotton in excess of the farm acreage allotment shall not be taken into account in establishing State, county, and farm acreage allotments. (7 U. S. C. 1344 (i).)

(j) Notwithstanding any other provision of this Act, State and county committees shall make available for inspection by owners or operators of farms receiving cotton acreage allotments all records pertaining to cotton acreage allotments and marketing quotas. (7 U. S. C. 1344 (j).)

(k) Notwithstanding any other provision of this section except subsection (g) (1), there shall be allotted to each State for which an allotment is made under this section not less than the smaller of (A) four thousand acres or (B) the highest acreage planted to cotton in any one of the three calendar years immediately preceding the year for which the allotment is made. (7 U. S. C. 1344 (k).)

(l) (This subsection relating to war crops under Public Law 12, Seventy-ninth Congress, does not apply to the 1955 and succeeding crops of cotton.) (7 U. S. C. 1344 (1).)

(m) Notwithstanding any other provision of law—

(1) Applicable only to 1954 crop of cotton)

(2) Any part of any farm cotton acreage allotment on which cotton will not be planted and which is voluntarily surrendered to the county committee shall b^ deducted from the allotment to such farm and may be reapportioned by the county committee to other farms in the same county receiving allotments in amounts determined by the county committee to be fair and reasonable on the basis of past acreage of cotton, land, labor, equipment available for the production of cotton, crop rotation practices, and soil and other physical facilities affecting the production of cotton. If all of the allotted acreage voluntarily sur-

[32] See p. 87 for section 378 which replaces this section.

rendered is not needed in the county, the county committee may surrender the excess acreage to the State committee to be used for the same purposes as the State acreage reserve under subsection (e) of this section; *but no such acreage shall be surrendered to the State committee so long as any farmer receiving a cotton acreage allotment in such county desires additional cotton acreage.*[33] Any allotment transferred under this provision shall be regarded for the purposes of subsection (f) of this section as having been planted on the farm from which transferred rather than on the farm to which transferred, except that this shall not operate to make the farm from which the allotment was transferred eligible for an allotment as having cotton planted thereon during the three-year base period: *Provided*, That notwithstanding any other provisions of law, any part of any farm acreage allotment may be permanently released in writing to the county committee by the owner and operator of the farm, and reapportioned as provided herein. Acreage surrendered, reapportioned under this paragraph, and planted shall be credited to the State and county in determining future acreage allotments. The provisions of this paragraph shall apply also to extra long staple cotton covered by section 347 of this Act.

(3) (Applicable only to 1954 crop of cotton.)

(n) Notwithstanding any other provision of this Act, if the Secretary determines that because of a natural disaster a substantial portion of the 1958 farm cotton acreage allotments in a county cannot be timely planted or replanted, he may authorize the transfer of all or a part of the cotton acreage allotment for any farm in the county so affected to another farm in the county or in an adjoining county on which one or more of the producers on the farm from which the transfer is to be made will be engaged in the production of cotton and will share in the proceeds thereof, in accordance with such regulations as the Secretary may prescribe. Acreage history credits for transferred acreage shall be governed by the provisions of subsection (m) (2) of this section pertaining to the release and reapportionment of acreage allotments. No transfer hereunder shall be made to a farm covered by a 1958 acreage reserve contract for cotton.[34] (7 U. S. C. 1334 (n).)

[Applicable only to 1958 crop of cotton.]

FARM MARKETING QUOTAS

SEC. 345. The farm marketing quota for any crop of cotton shall be the actual production of the acreage planted to cotton on the farm less the farm marketing excess. The farm marketing excess shall be the normal production of that acreage planted to cotton on the farm which is in excess of the farm acreage allotment: *Provided*, That such farm marketing excess shall not be larger than the amount by which the actual production of cotton on the farm exceeds the normal production of the farm acreage allotment, if the producer establishes such actual production to the satisfaction of the Secretary. (7 U. S. C. 1345.)

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[33] Material in italics enacted by Pub. L. 85–835, 72 Stat. 992, August 28, 1958.
[34] New subsection added by Pub. L. 85–456, 72 Stat. 186, June 11, 1958.

PENALTIES

SEC. 346. (a) Whenever farm marketing quotas are in effect with respect to any crop of cotton, the producer shall be subject to a penalty on the farm marketing excess at a rate per pound equal to 50 per centum of the parity price per pound for cotton as of June 15 of the calendar year in which such crop is produced. (7 U. S. C. 1346 (a).)

(b) The farm marketing excess of cotton shall be regarded as available for marketing and the amount of penalty shall be computed upon the normal production of the acreage on the farm planted to cotton in excess of the farm acreage allotment. If a downward adjustment in the amount of the farm marketing excess is made pursuant to the proviso in section 345, the difference between the amount of the penalty computed upon the farm marketing excess before such adjustment and as computed upon the adjusted farm marketing excess shall be returned to or allowed the producer (7 U. S. C. 1346 (b).)

(c) The person liable for payment or collection of the penalty shall be liable also for interest thereon at the rate of 6 per centum per annum from the date the penalty becomes due until the date of payment of such penalty. (7 U. S. C. 1346 (c).)

(d) Until the penalty on the farm marketing excess is paid, all cotton produced on the farm and marketed by the producer shall be subject to the penalty provided by this section and a lien on the entire crop of cotton produced on the farm shall be in effect in favor of the United States. (7 U. S. C. 1346 (d).)

LONG STAPLE COTTON

SEC. 347. (a) Except as otherwise provided by this section, the provisions of the Part shall not apply to extra long staple cotton which is produced from pure strain varieties of the Barbadense species, or any hybrid thereof, or other similar types of extra long staple cotton designated by the Secretary having characteristics needed for various end uses for which American upland cotton is not suitable, and grown in irrigated cotton-growing regions of the United States designated by the Secretary or other areas designated by the Secretary as suitable for the production of such varieties or types. (7 U. S. C. 1347 (a).)

(b) Whenever during any calendar year, not later than October 15, the Secretary determines that the total supply of cotton described in subsection (a) for the marketing year beginning in such calendar year will exceed the normal supply thereof for such marketing year by more than 8 per centum, the Secretary shall proclaim such fact and a national marketing quota shall be in effect for the crop of such cotton produced in the next calendar year. The Secretary shall also determine and specify in such proclamation the amount of the national marketing quota in terms of the quantity of cotton described in subsection (a) adequate to make available a normal supply of cotton, taking into account (1) the estimated carry-over at the beginning of the marketing year which begins in the next calendar year, and (2) the estimated imports during such marketing year: *Pro-*

vided, That beginning with the 1961 crop of extra long staple cotton, such national marketing quota shall be an amount equal to (1) the estimated domestic consumption plus exports for the marketing year which begins in the next calendar year, less (2) the estimated imports, plus (3) such additional number of bales, if any, as the Secretary determines is necessary to assure adequate working stocks in trade channels until cotton from the next crop becomes readily available without resort to Commodity Credit Corporation stocks.[35] The national marketing quota for cotton described in subsection (a) for any year shall not be less than the larger of thirty thousand bales or a number of bales equal to 30 per centum of the estimated domestic consumption plus exports of such cotton for the marketing year beginning in the calendar year in which such quota is proclaimed. (7 U. S. C. 1347 (b).)

(c) All provisions of this Act, except section 342, subsection (h), (k), and (l) of section 344, the parenthetical provisions relating to acreages regarded as having been planted to cotton, and the provisions relating to minimum small farm allotments, shall, insofar as applicable, apply to marketing quotas and acreage allotments authorized by this section: *Provided*, That the applicable penalty rate for such cotton under section 346 shall be the higher of 50 per centum of the parity price or 50 per centum of the support price for extra long staple cotton as of the date specified therein. (7 U. S. C. 1347 (c).)

(d) Unless marketing quotas are in effect under subsection (b) of this section, the penalty provisions of section 346 shall not apply to any cotton the staple of which is one and one-half inches or more in length. (7 U. S. C. 1347 (d).)

(e) The exemptions authorized by subsections (a) and (d) of this section shall not apply unless (1) the cotton is ginned on a roller-type gin or (2) the Secretary authorizes the cotton to be ginned on another type gin for experimental purposes or to prevent loss of the cotton due to frost or other adverse condition. (7 U. S. C. 1347 (e).)

INELIGIBILITY FOR PAYMENTS

SEC. 348. Repealed by Public Law 42, 84th Congress, (69 Stat. 65)

PART V—MARKETING QUOTAS—RICE

LEGISLATIVE FINDING

SEC. 351. (a) The marketing of rice constitutes one of the great basic industries of the United States with ramifying activities which directly affect interstate and foreign commerce at every point, and stable conditions therein are necessary to the general welfare. Rice produced for market is sold on a Nation-wide market, and, with its products, moves almost wholly in interstate and foreign commerce from the producer to the ultimate consumer. The farmers producing such commodity are subject in their operations to uncontrollable natural causes, in many cases such farmers carry on their farming operations on borrowed money or leased lands, and are not so situated as to be able to organize effectively, as can labor and industry,

[35] Material in italics enacted by Pub. L. 85–835, 72 Stat. 990, August 28, 1958.

through unions and corporations enjoying Government sanction and protection for joint economic action. For these reasons, among others, the farmers are unable without Federal assistance to control effectively the orderly marketing of such commodity with the result that abnormally excessive supplies thereof are produced and dumped indiscriminately on the Nation-wide market. (7 U. S. C. 1351 (a).)

(b) The disorderly marketing of such abnormally excessive supplies affects, burdens, and obstructs interstate and foreign commerce by (1) materially affecting the volume of such commodity marketed therein, (2) disrupting the orderly marketing of such commodity therein, (3) reducing the prices for such commodity with consequent injury and destruction of such commerce in such commodity, and (4) causing a disparity between the prices for such commodity in interstate and foreign commerce and industrial products therein, with a consequent diminution of the volume of interstate and foreign commerce in industrial products. (7 U. S. C. 1351 (b).)

(c) Whenever an abnormally excessive supply of rice exists, the marketing of such commodity by the producers thereof directly and substantially affects interstate and foreign commerce in such commodity and its products, and the operation of the provisions of this Part becomes necessary and appropriate in order to promote, foster, and maintain an orderly flow of such supply in interstate and foreign commerce. (7 U. S. C. 1351 (c).)

NATIONAL ACREAGE ALLOTMENT

SEC. 352. The national acreage allotment of rice for any calendar year shall be that acreage which the Secretary determines will, on the basis of the national average yield of rice for the five calendar years immediately preceding the calendar year for which such national average yield is determined, produce an amount of rice adequate, together with the estimated carry-over from the marketing year ending in such calendar year, to make available a supply for the marketing year commencing in such calendar year not less than the normal supply: *Provided, however*, That for 1956 no national acreage allotment shall be established which is less than 85 per centum of the final allotment established for the immediately preceding year. Such national acreage allotment shall be proclaimed not later than December 31 of each year. (7 U. S. C. 1352.)

APPORTIONMENT OF NATIONAL ACREAGE ALLOTMENT

SEC. 353. (a) The national acreage allotment of rice for each calendar year, less a reserve of not to exceed 1 per centum thereof for apportionment by the Secretary as provided in this subsection, shall be apportioned by the Secretary among the several States in which rice is produced in proportion to the average number of acres of rice in each State during the five-year period immediately preceding the calendar year for which such national acreage allotment of rice is determined (plus, in applicable years, the acreage diverted under previous agricultural adjustment and conservation programs) with adjustments for trends in acreage during the applicable period. The Secretary shall provide for the apportionment of the reserve acreage

set aside pursuant to this subsection to farms receiving allotments which are inadequate because of an insufficient State or county acreage allotment or because rice was not planted on the farm during all of the preceding five years. Notwithstanding the foregoing provisions of this subsection, the reserve acreage set aside for the 1950 crop pursuant to this subsection shall not exceed one-half of 1 per centum and shall be in addition to the 1950 national acreage allotment as heretofore proclaimed by the Secretary and apportioned by him among the several rice-producing States and shall be available for apportionment to new farms without regard to the limitation contained in subsection (b) of this section. (7 U. S. C. 1353 (a).)

(b) The State acreage allotment shall be apportioned to farms owned or operated by persons who have produced rice *in the State* in any one of the five calendar years immediately preceding the year for which such apportionment is made on the basis of past production of rice in the State by the producer on the farm taking into consideration the acreage allotments previously established in the State for such owners or operators; abnormal conditions affecting acreage; land, labor, and equipment available for the production of rice; crop rotation practices; and the soil and other physical factors affecting the production of rice: *Provided*, That if the State committee recommends such action and the Secretary determines that such action will facilitate the effective administration of the Act, he may provide for the apportionment of *part or all of* the State acreage allotment to farms on which rice has been produced during any one of such period of years on the basis of the foregoing factors, using past production of rice on the farm and the acreage allotments previously established for the farm in lieu of past production of rice by the producer and the acreage allotments previously established for such owners or operators. Not more than 3 per centum of the State acreage allotment shall be apportioned among farms operated by persons who will produce rice during the calendar year for which the allotment is made but who have not produced rice *in the State* in any one of the past five years, on the basis of the applicable apportionment factors set forth herein: *Provided further, That if the Secretary determines that part of the State acreage allotment shall be apportioned on the basis of past production of rice by the producer on the farm and part on the basis of the past production of rice on the farm, he shall divide the State into two administrative areas, to be designated "producer administrative area" and "farm administrative area", respectively, which areas shall be separated by a natural barrier which would prevent each area from being readily accessible to rice producers in one area for producing rice in the other area, and each such area shall be composed of whole counties:*[36] *Provided*, That in any State in which allotments are established for farms on the basis of past production of rice on the farm such percentage of the State acreage allotment shall be apportioned among

[36] Sec. 2c of Pub. L. 85–443, 72 Stat. 177, June 4, 1958, provides that the sentence preceding this footnote "shall become effective for the 1958 and subsequent crops of rice: *Provided*, That if any State is divided into administrative areas for 1958 pursuant to section 353 (b) of the Act, as amended, acreage allotments heretofore established for farms in such areas shall be redetermined to the extent required as a result of such division: *Provided further*, That the allotment heretofore established for any farm shall not be reduced as a result of such redetermination. The additional acreage, if any, required to provide such minimum allotments shall be in addition to the 1958 National and State acreage allotments."

the farms on which rice is to be planted during the calendar year for which the apportionment is made but on which rice was not planted during any of the past five years, on the basis of the applicable apportionment factors set forth herein. *In determining the eligibility of any producer or farm for an allotment as an old producer or farm under the first sentence of this subsection or as a new producer or farm under the second sentence of this subsection, such producer or farm shall not be considered to have produced rice on any acreage which under subsection (c) (2) is either not to be taken into account in establishing acreage allotments or is not to be credited to such producer.*[37] *For purposes of this section in States which have been divided into administrative areas pursuant to this subsection the term "State acreage allotment" shall be deemed to mean that part of the State acreage allotment apportioned to each administrative area and the word "State" shall be deemed to mean "administrative area", wherever applicable.* (7 U. S. C. 1353 (b).)[38] [The portions in italics in section 353(b) was added by Pub. L. 85-443, 72 Stat. 177, June 4, 1958.]

(c) Notwithstanding any other provisions of this Act—

(1) If farm acreage allotments are established by using past production of rice on the farm and the acreage allotments previously established for the farm in lieu of past production of rice by the producer and the acreage allotments previously established for owners or operators, the State acreage allotment shall be apportioned among counties in the State on the same basis as the national acreage allotment is apportioned among the States and the county acreage allotments shall be apportioned to farms on the basis of the applicable factors set forth in subsection (b) of this section: *Provided, That if the State is divided into administrative areas pursuant to subsection (b) of this section the allotment for each administrative area shall be determined by apportioning the State acreage allotment among counties as provided in this subsection and totaling the allotments for the counties in such area:*[39] *Provided*, That the State committee may reserve not to exceed 5 per centum of the State allotment, which shall be used to make adjustments in county allotments for trends in acreage and for abnormal conditions affecting plantings;

(2) Any acreage planted to rice in excess of the farm acreage allotment shall not be taken into account in establishing State, county, and farm acreage allotments.

In determining the past production of rice by producers on a farm for the purpose of establishing farm acreage allotments for the 1956 and subsequent crops, the acreage of rice on the farm for any year for which farm acreage allotments were in effect shall be divided among the producers thereon in the proportion in which they contributed to the farm acreage allotment.

(3) Each of the State acreage allotments for 1955 heretofore proclaimed by the Secretary shall be increased by 2 per centum

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[37] Sec. 1 of Pub. L. 85–443, 72 Stat. 177, June 4, 1958, provides that the sentence preceding this footnote "shall be applicable to the planting of rice in 1958 and subsequent years."

[38] Footnote 36 is also applicable to this sentence.

[39] New proviso added by Pub. L. 85–443, 72 Stat. 177, June 4, 1958. Footnote 36 is also applicable to this new proviso.

or by such greater acreage as may be necessary to provide such State with an allotment equal to its 1950 allotment. In any State having county acreage allotments for 1955 (i) the increase in the State allotment shall be apportioned among counties in the State on the same basis as the State allotment was heretofore apportioned among the counties, but without regard to adjustments for trends in acreage, and (ii) the 1955 allotment for any county in which the 1950–1954 average planted plus diverted acreage of rice, adjusted for trends in acreage, exceeds the 1945–1949 average planted acreage of rice, similarly adjusted, by more than 2 per centum shall then be further increased by such additional acreage as may be necessary to provide such county with an allotment equal to its 1950 allotment. The increases in the county acreage allotments and the increases in the State allotments, where county allotments are not determined, shall be used to establish farm acreage allotments which are fair and reasonable in relation to the applicable allotment factors specified in subsection (b) of this section and to correct inequities and prevent hardships.

(4) The reserve acreage made available for 1955 in any State for apportionment to farms operated by persons who have not produced rice during the preceding five years or on which rice has not been planted in the preceding five years shall not be less than five hundred acres; and the additional acreage necessary to provide such minimum reserve acreages shall be in addition to the National and State acreage allotments.

(5) Each of the State acreage allotments for 1956 heretofore proclaimed by the Secretary, after adding thereto any acreage apportioned to farms in the State from the reserve acreage set aside pursuant to subsection (a) of this section, shall be increased by such amount as may be necessary to provide such State with an allotment of not less than 85 per centum of its final allotment established for 1955. Any additional acreage required to provide such minimum allotment shall be additional to the national acreage allotment. In any State having county acreage allotments for 1956, the increase in the State allotment shall be apportioned among counties in the State on the same basis as the State allotment was heretofore apportioned among the counties, but without regard to adjustments for trends in acreage.

(6) The national acreage allotments of rice for 1957 and 1958 shall be not less than the national acreage allotment for 1956, including any acreage allotted under paragraph (5) of this subsection, and such national allotments for *1957 and subsequent years* shall be apportioned among the States in the same proportion that they shared in the total acreage allotted in 1956.[40] (7 U. S. C. 1353 (c).)

(d) The provisions of this part shall not apply to nonirrigated rice produced on any farm on which the acreage planted to nonirrigated rice does not exceed three acres or to rice produced outside the continental United States. (7 U. S. C. 1353 (d).)

[40] The words "1957 and subsequent years" substituted for "1957 and 1958" by Pub. L. 85–835, 72 Stat. 994, August 28, 1958.

(e) Any part of the farm rice acreage allotment on which rice will not be planted and which is voluntarily surrendered to the county committee shall be deducted from the allotment to such farm and may be reapportioned by the county committee to other farms in the same county receiving allotments in amounts determined by the county committee to be fair and reasonable on the basis of the past production of rice by the producers on the farm or the past production of rice on the farm, as the case may be; acreage allotments previously established for the farm or for the producers on the farm, as the case may be; abnormal conditions affecting acreage; land, labor, water, and equipment available for the production of rice; crop-rotation practices; and the soil and other physical factors affecting the production of rice. Any allotment surrendered under this provision shall be regarded for the purposes of subsection (b) of this section as having been planted on the farm from which surrendered, except that this shall not operate to make the farm from which the allotment was surrendered eligible for an allotment as having rice planted thereon, or to make any producer thereon eligible for an allotment as having produced rice, during the five-year base period. (7 U. S. C. 1353 (e).)

(f) Repealed by Public Law 85–835, 72 Stat. 988, August 28, 1958.[41]

MARKETING QUOTAS

SEC. 354. (a) Whenever in any calendar year the Secretary determines that the total supply of rice for the marketing year beginning in such calendar year will exceed the normal supply for such marketing year by more than 10 per centum, the Secretary shall not later than December 31 of such calendar year proclaim such fact and marketing quotas shall be in effect for the crop of rice produced in the next calendar year. (7 U. S. C. 1354 (a).)

(b) Within thirty days after the date of the issuance of the proclamation specified in subsection (a) of this section, the Secretary shall conduct a referendum by secret ballot of farmers engaged in the production of the immediately preceding crop of rice to determine whether such farmers are in favor of or opposed to such quotas. If more than one-third of the farmers voting in the referendum oppose such quotas the Secretary shall, prior to the 15th day of February, proclaim the result of the referendum and such quotas shall become ineffective. (7 U. S. C. 1354 (b).)

AMOUNT OF FARM MARKETING QUOTA

SEC. 355. The farm marketing quota for any crop of rice shall be the actual production of rice on the farm less the normal production of the acreage planted to rice on the farm in excess of the farm acreage allotment. The normal production from such excess acreage shall be known as the "farm marketing excess": *Provided*, That the farm marketing excess shall not be larger than the amount by which the actual production of rice on the farm exceeds the normal production of the farm acreage allotment if the producer establishes such actual production to the satisfaction of the Secretary. (7 U. S. C. 1355.)

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[41] Sec. 353 (f) enacted by Pub. L. 85–443, 72 Stat. 178, June 4, 1958, was repealed by Pub. L. 85–835, 72 Stat. 995, August 28, 1958. Section 378, on p. 87, replaced sec. 354 (f).

PENALTIES AND STORAGE

SEC. 356 (a) Whenever farm marketing quotas are in effect with respect to any crop of rice, the producer shall be subject to a penalty on the farm marketing excess at a rate per pound equal to 50 per centum of the parity price per pound for rice as of June 15 of the calendar year in which such crop is produced. *Effective beginning with the 1958 crop, the rate of penalty on rice shall be 65 per centum of the parity price per pound for rice as of June 15 of the calendar year in which the crop is produced.*[42] (7 U. S. C. 1356 (a).)

(b) The farm marketing excess of rice shall be regarded as available for marketing and the amount of penalty shall be computed upon the normal production of the acreage on the farm planted to rice in excess of the farm acreage allotment. If a downward adjustment in the amount of the farm marketing excess is made pursuant to the proviso in section 355, the difference between the amount of the penalty computed upon the farm marketing excess before such adjustment and as computed upon the adjusted marketing excess shall be returned to or allowed the producer. (7 U. S. C. 1356 (b).)

(c) The person liable for payment or collection of the penalty shall be liable also for interest thereon at the rate of 6 per centum per annum from the date the penalty becomes due until the date of payment of such penalty. (7 U. S. C. 1356 (c).)

(d) Until the penalty on the farm marketing excess is paid, postponed, or avoided, as provided herein, all rice produced on the farm and marketed by the producer shall be subject to the penalty provided by this section and a lien on the entire crop of rice produced on the farm shall be in effect in favor of the United States. (7 U. S. C. 1356 (d).)

(e) The penalty on the farm marketing excess on any crop of rice may be avoided or postponed by storage or by disposing of the commodity in such other manner, not inconsistent with the purposes of this Act, as the Secretary shall prescribe, including, in the discretion of the Secretary, delivery to Commodity Credit Corporation or any other agency within the Department. The Secretary shall issue regulations governing such storage or other disposition. Unless otherwise specified by the Secretary in such regulations, any quantity of rice so stored or otherwise disposed of shall be of those types and grades which are representative of the entire quantity of rice produced on the farm. Upon failure so to store or otherwise dispose of the farm marketing excess of rice within such time as may be determined under regulations prescribed by the Secretary, the penalty on such excess shall become due and payable. Any rice delivered to any agency of the Department pursuant to this subsection shall become the property of the agency to which delivered and shall be disposed of at the direction of the Secretary in a manner not inconsistent with the purposes of this Act. (7 U. S. C. 1356 (e).)

(f) Subject to the provisions of subsection (g) of this section, the penalty upon the farm marketing excess stored pursuant to this section shall be paid by the producer at the time and to the extent of any depletion in the amount so stored except depletion resulting from some

[42] Material in italics added by Pub. L. 85-443, 72 Stat. 178, June 4, 1958.

cause beyond the control of the producer or from substitution of the commodity authorized by the Secretary. (7 U. S. C. 1356 (f).)

(g) (1) If the planted acreage of the then current crop of rice for any farm is less than the farm acreage allotment, the amount of the commodity from any previous crop of rice stored to postpone or avoid payment of the penalty shall be reduced by an amount equal to the normal production of the number of acres by which the farm acreage allotment exceeds the acreage planted to rice.

(2) If the actual production of the acreage of rice on any farm on which the acreage of rice is within the farm acreage allotment is less than the normal production of the farm acreage allotment, the amount of rice from any previous crop stored to postpone or avoid payment of the penalty shall be reduced by an amount which, together with the actual production of the then current crop will equal the normal production of the farm acreage allotment: *Provided*, That the reduction under this paragraph shall not exceed the amount by which the normal production of the farm acreage allotment less any reduction made under paragraph (1) of this subsection is in excess of the actual production of the acreage planted to rice on the farm. (7 U. S. C. 1356 (g).)

(h) Whenever, in any marketing year, marketing quotas are not in effect with respect to the crop of rice produced in the calendar year in which such marketing year begins, all marketing quotas applicable to previous crops of rice shall be terminated, effective as of the first day of such marketing year. Such termination shall not abate any penalty previously incurred by a producer or relieve any buyer of the duty to remit penalties previously collected by him. (7 U. S. C. 1356 (h).)[43]

PART VI—MARKETING QUOTAS—PEANUTS

LEGISLATIVE FINDINGS

SEC. 357. The production, marketing, and processing of peanuts and peanut products employs a large number of persons and is of national interest. The movement of peanuts from producer to consumer is preponderantly in interstate and foreign commerce, and, owing to causes beyond their control, the farmers producing such commodity and the persons engaged in the marketing and processing thereof are unable to regulate effectively the orderly marketing of the commodity. As the quantity of peanuts marketed in the channels of interstate and foreign commerce increases above the quantity of peanuts needed for cleaning and shelling, the prices at which all peanuts are marketed are depressed to low levels. These low prices tend to cause the quantity of peanuts available for marketing in later years to be less than normal, which in turn tends to cause relatively high prices. This fluctuation of prices and marketings of peanuts creates an unstable and chaotic condition in the marketing of peanuts for cleaning and shelling and for crushing for oil in the channels of interstate and foreign commerce. Since these unstable and chaotic conditions have existed for a period of years and are likely, without

[43] New subsection (h) added by Pub. L. 85–443, 72 Stat. 178, June 4, 1958.

proper regulation, to continue to exist, it is imperative that the marketing of peanuts for cleaning and shelling and for crushing for oil in interstate and foreign commerce be regulated in order to protect producers, handlers, processors, and consumers. (7 U. S. C. 1357.)

MARKETING QUOTAS

SEC. 358. (a) Between July 1 and December 1 of each calendar year the Secretary shall proclaim the amount of the national marketing quota for peanuts for the crop produced in the next succeeding calendar year in terms of the total quantity of peanuts which will make available for marketing a supply of peanuts from the crop with respect to which the quota is proclaimed equal to the average quantity of peanuts harvested for nuts during the five years immediately preceding the year in which such quota is proclaimed, adjusted for current trends and prospective demand conditions, and the quota so proclaimed shall be in effect with respect to such crop. The national marketing quota for peanuts for any year shall be converted to a national acreage allotment by dividing such quota by the normal yield per acre of peanuts for the United States determined by the Secretary on the basis of the average yield per acre of peanuts in the five years preceding the year in which the quota is proclaimed, with such adjustments as may be found necessary to correct for trends in yields and for abnormal conditions of production affecting yields in such five years: *Provided*, That the national marketing quota established for the crop produced in the calendar year 1941 shall be a quantity of peanuts sufficient to provide a national acreage allotment of not less than one million six hundred and ten thousand acres, and that the national marketing quota established for any subsequent year shall be a quantity of peanuts sufficient to provide a national acreage allotment of not less than that established for the crop produced in the calendar year 1941. (7 U. S. C. 1358 (a).)

(b) Not later than December 15 of each calendar year the Secretary shall conduct a referendum of farmers engaged in the production of peanuts in the calendar year in which the referendum is held to determine whether such farmers are in favor of or opposed to marketing quotas with respect to the crops of peanuts produced in the three calendar years immediately following the year in which the referendum is held, except that, if as many as two-thirds of the farmers voting in any referendum vote in favor of marketing quotas, no referendum shall be held with respect to quotas for the second and third years of the period. The Secretary shall proclaim the results of the referendum within thirty days after the date on which it is held, and, if more than one-third of the farmers voting in the referendum vote against marketing quotas, the Secretary also shall proclaim that marketing quotas will not be in effect with respect to the crop of peanuts produced in the calendar year immediately following the calendar year in which the referendum is held. (7 U. S. C. 1358 (b).)

(c) (1) The national acreage allotment for 1951, less the acreage to be allotted to new farms under subsection (f) of this section, shall be apportioned among the States on the basis of the larger of the following for each State: (a) The acreage allotted to the State as its

share of the 1950 national acreage allotment of two million one hundred thousand acres, or (b) the State's share of two million one hundred thousand acres apportioned to States on the basis of the average acreage harvested for nuts in each State in the five years 1945-49: *Provided*, That any allotment so determined for any State which is less than the 1951 State allotment announced by the Secretary prior to the enactment of this Act shall be increased to such announced allotment and the acreage required for such increases shall be in addition to the 1951 national acreage allotment and shall be considered in determining State acreage allotments in future years. For any year subsequent to 1951, the national acreage allotment for that year, less the acreage to be allotted to new farms under subsection (f) of this section, shall be apportioned among the States on the basis of their share of the national acreage allotment for the most recent year in which such apportionment was made.

(2) Notwithstanding any other provision of law, if the Secretary of Agriculture determines, on the basis of the average yield per acre of peanuts by types during the preceding five years, adjusted for trends in yields and abnormal conditions of production affecting yields in such five years, that the supply of any type or types of peanuts for any marketing year, beginning with the 1951-52 marketing year, will be insufficient to meet the estimated demand for cleaning and shelling purposes at prices at which the Commodity Credit Corporation may sell for such purposes peanuts owned or controlled by it, the State allotments for those States producing such type or types of peanuts shall be increased to the extent determined by the Secretary to be required to meet such demand but the allotment for any State may not be increased under this provision above the 1947 harvested acreage of peanuts for such State. The total increase so determined shall be apportioned among such States for distribution among farms producing peanuts of such type or types on the basis of the average acreage of peanuts of such type or types in the three years immediately preceding the year for which the allotments are being determined. The additional acreage so required shall be in addition to the national acreage allotment, the production from such acreage shall be in addition to the national marketing quota, and the increase in acreage allotted under this provision shall not be considered in establishing future State, county, or farm acreage allotments. (7 U. S. C. 1358 (c).)

(d) The Secretary shall provide for apportionment of the State acreage allotment for any State through local committees among farms on which peanuts were grown in any of the three years immediately preceding the year for which such allotment is determined. The State acreage allotment for 1952 and any subsequent year shall be apportioned among farms on which peanuts were produced in any one of the 3 calendar years immediately preceding the year for which such apportionment is made, on the basis of the following: Past acreage of peanuts, taking into consideration the acreage allotments previously established for the farm; abnormal conditions affecting acreage; land, labor, and equipment available for the production of peanuts; crop-rotation practices; and soil and other physical factors affecting the production of peanuts. Any acreage of peanuts harvested in

excess of the allocated acreage for any farm for any year shall not be considered in the establishment of the allotment for the farm in succeeding years. The amount of the marketing quota for each farm shall be the actual production of the farm acreage allotment, and no peanuts shall be marketed under the quota for any farm other than peanuts actually produced on the farm. (7 U. S. C. 1358 (d)).[44]

(e) Notwithstanding the foregoing provisions of this section, the Secretary may, if the State committee recommends such action and the Secretary determines that such action will facilitate the effective administration of the provisions of the Act, provide for the apportionment of the State acreage allotment for 1952 and any subsequent your among the counties in the State on the basis of the past acreage of peanuts harvested for nuts (excluding acreage in excess of farm allotments) in the county during the five years immediately preceding the year in which such apportionment is made, with such adjustments as are deemed necessary for abnormal conditions affecting acreage, for trends in acreage, and for additional allotments for types of peanuts in short supply under the provisions of subsection (c). The county acreage allotment shall be apportioned among farms on the basis of the factors set forth in subsection (d) of this section. (7 U. S. C. 1358 (e))

(f) Not more than one per centum of the national acreage allotment shall be apportioned among farms on which peanuts are to be produced during the calendar year for which the allotment is made but on which peanuts were not produced during any one of the past three years, on the basis of the following: Past peanut-producing experience by the producers; land, labor, and equipment available for the production of peanuts; crop-rotation practices; and soil and other physical factors affecting the production of peanuts. (7 U. S. C. 1358 (f))

(g) Any part of the acreage allotted to individual farms under the provisions of this section on which peanuts will not be produced and which is voluntarily surrendered to the county committee shall be deducted from the allotments to such farms and may be reapportioned by the county committee to other farms in the same county receiving allotments, in amounts determined by the county committee to be fair and reasonable on the basis of land, labor, and equipment available for the production of peanuts, crop-rotation practices, and soil and other physical factors affecting the production of peanuts. Any transfer of allotments under this provision shall not operate to reduce the allotment for any subsequent year for the farm from which acreage is transferred, except as the farm becomes ineligible for an allotment by failure to produce peanuts during a three-year period, and any such transfer shall not operate to increase the allotment for any subsequent year for the farm to which the acreage is transferred: *Provided*, That, notwithstanding any other provisions of this Act, any part of any farm acreage allotment may be permanently released in writing to the county committee by the owner and operator of the farm, and reapportioned as provided herein. (7 U. S. C. 1358 (g))

(h)[45]

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[44] Sec. 2 of Act of April 12, 1951 (65 Stat. 29), amended this subsection by "changing the second sentence * * *." Sec. 1358 (d) of Title 7, U. S. Code, 1952 ed., carries only the amended second sentence. The complete subsection is given above.

[45] See p. 87. Section 378 replaces this section.

(i) The production of peanuts on a farm in 1959 or any subsequent year for which no farm acreage allotment was established shall not make the farm eligible for an allotment as an old farm under subsection (d) of this section: Provided, however, That by reason of such production the farm need not be considered as ineligible for a new farm allotment under subsection (f) of this section, but such production shall not be deemed past experience in the production of peanuts for any producer on the farm. (7 U. S. C. 1358 (j).)[46]

MARKETING PENALTIES

SEC. 359. (a) The marketing of any peanuts in excess of the marketing quota for the farm on which such peanuts are produced, or the marketing of peanuts from any farm for which no acreage allotment was determined, shall be subject to a penalty at a rate equal to 75 per centum of the support price for peanuts for the marketing year (August 1–July 31). Such penalty shall be paid by the person who buys or otherwise acquires the peanuts from the producer, or if the peanuts are marketed by the producer through an agent, the penalty shall be paid by such agent, and such person or agent may deduct an amount equivalent to the penalty from the price paid to the producer. The Secretary may require collection of the penalty upon a portion of each lot of peanuts marketed from the farm equal to the proportion which the acreage of peanuts in excess of the farm-acreage allotment is of the total acreage of peanuts on the farm. If the person required to collect the penalty fails to collect such penalty, such person and all persons entitled to share in the peanuts marketed from the farm or the proceeds thereof shall be jointly and severally liable for the amount of the penalty. All funds collected pursuant to this section shall be deposited in a special deposit account with the Treasurer of the United States and such amounts as are determined, in accordance with regulations prescribed by the Secretary, to be penalties incurred shall be transferred to the general fund of the Treasury of the United States. Amounts collected in excess of determined penalties shall be paid to such producers as the Secretary determines, in accordance with regulations prescribed by him, bore the burden of the payment of the amount collected. Such special account shall be administered by the Secretary and the basis for, the amount of, and the producer entitled to receive a payment from such account, when determined in accordance with regulations prescribed by the Secretary, shall be final and conclusive. Peanuts produced in a calendar year in which marketing quotas are in effect for the marketing year beginning therein shall be subject to such quotas even though the peanuts are marketed prior to the date on which such marketing year begins. If any producer falsely identifies or fails to account for the disposition of any peanuts, an amount of peanuts equal to the normal yield of the number of acres harvested in excess of the farm acreage allotment shall be deemed to have been marketed in excess of the marketing quota for the farm, and the penalty in respect thereof shall be paid and remitted by the producer. If any amount of peanuts produced on one farm is falsely identified by a representation that

[46] New subsection (i) added by Pub. L. 85–717, 72 Stat. 709, August 21, 1958.

such peanuts were produced on another farm, the acreage allotments next established for both such farms shall be reduced by that percentage which such amount was of the respective farm marketing quotas, except that such reduction for any such farm shall not be made if the Secretary through the local committee finds that no person connected with such farm caused, aided, or acquiesced in such marketing; and if proof of the disposition of any amount of peanuts is not furnished as required by the Secretary, the acreage allotment next established for the farm on which such peanuts are produced shall be reduced by a percentage similarly computed. Notwithstanding any other provisions of this title, no refund of any penalty shall be made because of peanuts kept on the farm for seed or for home consumption. (7 U. S. C. 1359 (a))

(b) The provisions of this part shall not apply, beginning with the 1959 crop, to peanuts produced on any farm on which the acreage harvested for nuts is one acre or less provided the producers who share in the peanuts produced on such farm do not share in the peanuts produced on any other farm. If the producers who share in the peanuts produced on a farm on which the acreage harvested for nuts is one acre or less also share in the peanuts produced on other farm(s) the peanuts produced on such farm on acreage in excess of the allotment, if any, determined for the farm shall be considered as excess acreage and the marketing penalties provided by section 359 (a) shall apply.[47] (7 U. S. C. 1359 (b).)

(c) *The word "peanuts" for the purposes of this Act shall mean all peanuts produced, excluding any peanuts which it is established by the producer or otherwise, in accordance with regulations of the Secretary, were not picked or threshed either before or after marketing from the farm, or were marketed by the producer before drying or removal of moisture from such peanuts either by natural or artificial means for consumption exclusively as boiled peanuts.*[48] (This portion in italics is effective for the 1957, 1958, and 1959 crops of peanuts.) (7 U. S. C. 1359 (c))

(d) The person liable for payment or collection of the penalty provided by this section shall be liable also for interest thereon at the rate of 6 per centum per annum from the date the penalty becomes due until the date of payment of such penalty. (7 U. S. C. 1359 (d))

(e) Until the amount of the penalty provided by this section is paid, a lien on the crop of peanuts with respect to which such penalty is incurred, and on any subsequent crop of peanuts subject to marketing quotas in which the person liable for payment of the penalty has an interest shall be in effect in favor of the United States. (7 U. S. C. 1359 (e))

[Subsections (f), (g), (h), and (i) of this section were repealed by Public Law 285, Eighty-second Congress, approved March 28, 1952 (66 Stat. 27),[49] effective beginning with the 1952 crop of peanuts.]

[47] New subsection (b) enacted by Pub. L. 85–717, 72 Stat. 709, August 21, 1958.
[48] New subsection (c) enacted by Pub. L. 85–127, 71 Stat. 344, August 13, 1957.
[49] Repeal of these subsections shall not affect rights or obligations arising under marketing-quota or price-support operations with respect to 1951 or prior crops of peanuts. (66 Stat. 27.)

SUBTITLE C—ADMINISTRATIVE PROVISIONS

PART I—PUBLICATION AND REVIEW OF QUOTAS

APPLICATION OF PART

SEC. 361. This Part shall apply to the publication and review of farm marketing quotas established for tobacco, corn, wheat, cotton, peanuts, and rice, established under subtitle B. (7 U. S. C. 1361)

PUBLICATION AND NOTICE OF QUOTA

SEC. 362. All acreage allotments, and the farm marketing quotas established for farms in a county or other local administrative area shall, in accordance with regulations of the Secretary, be made and kept freely available for public inspection in such county or other local administrative area. An additional copy of this information shall be kept available in the office of the county agricultural extension agent or with the chairman of the local committee. Notice of the farm marketing quota of his farm shall be mailed to the farmer. Notice of the farm acreage allotment established for each farm shown by the records of the county committee to be entitled to such allotment shall insofar as practicable be mailed to the farm operator in sufficient time to be received prior to the date of the referendum. (7 U. S. C. 1362)

REVIEW BY REVIEW COMMITTEE

SEC. 363. Any farmer who is dissatisfied with his farm marketing quota may, within fifteen days after mailing to him of notice as provided in section 362, have such quota reviewed by a local review committee composed of three farmers from the same or nearby counties appointed by the Secretary. Such committee shall not include any member of the local committee which determined the farm acreage allotment, the normal yield, or the farm marketing quota for such farm. Unless application for review is made within such period, the original determination of the farm marketing quota shall be final. (7 U. S. C. 1363)

REVIEW COMMITTEE

SEC. 364. The members of the review committee shall receive as compensation for their services the same per diem as that received by the members of the committee utilized for the purposes of the Soil Conservation and Domestic Allotment Act, as amended. The members of the review committee shall not be entitled to receive compensation for more than thirty days in any one year. (7 U. S. C. 1364)

INSTITUTION OF PROCEEDINGS

SEC. 365. If the farmer is dissatisfied with the determination of the review committee, he may, within fifteen days after a notice of such determination is mailed to him by registered mail, file a bill in equity against the review committee as defendant in the United States district court, or institute proceedings for review in any court of record of the State having general jurisdiction, sitting in the county or the

district in which his farm is located, for the purpose of obtaining a review of such determination. Bond shall be given in an amount and with surety satisfactory to the court to secure the United States for the costs of the proceeding. The bill of complaint in such proceeding may be served by delivering a copy thereof to any one of the members of the review committee. Thereupon the review committee shall certify and file in the court a transcript of the record upon which the determination complained of was made, together with its findings of fact. (7 U. S. C. 1365)

COURT REVIEW

Sec. 366. The review by the court shall be limited to questions of law, and the findings of fact by the review committee, if supported by evidence, shall be conclusive. If application is made to the court for leave to adduce additional evidence, and it is shown to the satisfaction of the court that such additional evidence is material and that there were reasonable grounds for failure to adduce such evidence in the hearing before the review committee, the court may direct such additional evidence to be taken before the review committee in such manner and upon such terms and conditions as to the court may seem proper. The review committee may modify its findings of fact or its determination by reason of the additional evidence so taken, and it shall file with the court such modified findings or determination, which findings of fact shall be conclusive. At the earliest convenient time, the court, in term time or vacation, shall hear and determine the case upon the original record of the hearing before the review committee, and upon such record as supplemented, if supplemented, by further hearing before the review committee pursuant to direction of the court. The court shall affirm the review committee's determination, or modified determination, if the court determines that the same is in accordance with law. If the court determines that such determination or modified determination is not in accordance with law, the court shall remand the proceeding to the review committee with direction either to make such determination as the court shall determine to be in accordance with law or to take such further proceedings as, in the court's opinion, the law requires. (7 U. S. C. 1366.)

STAY ON PROCEEDINGS AND EXCLUSIVE JURISDICTION

Sec. 367. The commencement of judicial proceedings under this Part shall not, unless specifically ordered by the court, operate as a stay of the review committee's determination. Notwithstanding any other provision of law, the jurisdiction conferred by this Part to review the legal validity of a determination made by a review committee pursuant to this Part shall be exclusive. No court of the United States or of any State shall have jurisdiction to pass upon the legal validity of any such determination except in a proceeding under this Part. (7 U. S. C. 1367.)

NO EFFECT ON OTHER QUOTAS

Sec. 368. Notwithstanding any increase of any farm marketing quota for any farm as a result of review of the determination thereof

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under this Part, the marketing quotas for other farms shall not be affected. (7 U. S. C. 1368.)

PART II—ADJUSTMENT OF QUOTAS AND ENFORCEMENT

GENERAL ADJUSTMENTS OF QUOTAS

SEC. 371. (a) If at any time the Secretary has reason to believe that in the case of corn, wheat, cotton, rice, peanuts, or tobacco the operation of farm marketing quotas in effect will cause the amount of such commodity which is free of marketing restrictions to be less than the normal supply for the marketing year for the commodity then current, he shall cause an immediate investigation to be made with respect thereto. In the course of such investigation due notice and opportunity for hearing shall be given to interested persons. If upon the basis of such investigation the Secretary finds the existence of such fact, he shall proclaim the same forthwith. He shall also in such proclamation specify such increase in, or termination of, existing quotas as he finds, on the basis of such investigation, is necessary to make the amount of such commodity which is free of marketing restrictions equal the normal supply. (7 U. S. C. 1371 (a).)

(b) If the Secretary has reason to believe that, because of a national emergency or because of a material increase in export demand, any national acreage allotment for corn or any national marketing quota or acreage allotment for wheat, cotton, rice, peanuts, or tobacco should be increased or terminated, he shall cause an immediate investigation to be made to determine whether the increase or termination is necessary in order to effect the declared policy of this Act or to meet such emergency or increase in export demand. If, on the basis of such investigation, the Secretary finds that such increase or termination is necessary, he shall immediately proclaim such finding (and if he finds an increase is necessary, the amount of the increase found by him to be necessary) and thereupon such quota or allotment shall be increased, or shall terminate, as the case may be. (7 U. S. C. 1371 (b).)

(c) In case any national marketing quota or acreage allotment for any commodity is increased under this section, each farm marketing quota or acreage allotment for the commodity shall be increased in the same ratio. (7 U. S. C. 1371 (c).)

(d) (Deleted by 68 Stat. 905, August 28, 1954.)

PAYMENT AND COLLECTION OF PENALTIES

SEC. 372. (a) The penalty with respect to the marketing, by sale, of wheat, cotton, or rice, if the sale is to any person within the United States, shall be collected by the buyer. (7 U. S. C. 1372 (a).)

(b) All penalties provided for in Subtitle B shall be collected and paid in such manner, at such times, and under such conditions as the Secretary may by regulations prescribe. Such penalties shall be remitted to the Secretary by the person liable for the penalty, except that if any other person is liable for the collection of the penalty, such other person shall remit the penalty. The amount of such penalties shall be covered into the general fund of the Treasury of the United States. (7 U. S. C. 1372 (b).)

(c) Whenever, pursuant to a claim filed with the Secretary within two years after payment to him of any penalty collected from any person pursuant to this Act, the Secretary finds that such penalty was erroneously, illegally, or wrongfully collected and that the claimant bore the burden of the payment of such penalty, the Secretary shall certify to the Secretary of the Treasury for payment to the claimant, in accordance with regulations prescribed by the Secretary of the Treasury, such amount as the Secretary finds the claimant is entitled to receive, as a refund of such penalty.

Notwithstanding any other provision of law, the Secretary is authorized to prescribe by regulations for the identification of farms and it shall be sufficient to schedule receipts into special deposit accounts or to schedule such receipts for transfer therefrom, or directly, into the separate fund provided for in subsection (b) hereof by means of such identification without reference to the names of the producers on such farms.

The Secretary is authorized to prescribe regulations governing the filing of such claims and the determination of such refunds. (7 U. S. C. 1372 (c).)

(d) No penalty shall be collected under this Act with respect to the marketing of any agricultural commodity grown for experimental purposes only by any publicly owned agricultural experiment station. (7 U. S. C. 1372 (d).)

REPORTS AND RECORDS

SEC. 373. (a) This subsection shall apply to warehousemen, processors, and common carriers of corn, wheat, cotton, rice, peanuts, or tobacco, and all ginners of cotton, all persons engaged in the business of purchasing corn, wheat, cotton, rice, peanuts, or tobacco from producers, all persons engaged in the business of redrying, prizing, or stemming tobacco for producers, all brokers and dealers in peanuts, all agents marketing peanuts for producers, or acquiring peanuts for buyers and dealers, and all peanut growers' cooperative associations, all persons engaged in the business of cleaning, shelling, crushing, and salting of peanuts and the manufacture of peanut products, and all persons owning or operating peanut-picking or peanut-threshing machines. Any such person shall, from time to time on request of the Secretary, report to the Secretary such information and keep such records as the Secretary finds to be necessary to enable him to carry out the provisions of this title. Such information shall be reported and such records shall be kept in accordance with forms which the Secretary shall prescribe. For the purpose of ascertaining the correctness of any report made or record kept, or of obtaining information required to be furnished in any report, but not so furnished, the Secretary is hereby authorized to examine such books, papers, records, accounts, correspondence, contracts, documents, and memoranda as he has reason to believe are relevant and are within the control of such person. Any such person failing to make any report or keep any record as required by this subsection or making any false report or record shall be deemed guilty of a misdemeanor and upon conviction thereof shall be subject to a fine of not more than $500; and any to-

bacco warehouseman or dealer who fails to remedy such violation by making a complete and accurate report or keeping a complete and accurate record as required by this subsection within fifteen days after notice to him of such violation shall be subject to an additional fine of $100 for each ten thousand pounds of tobacco, or fraction thereof, bought or sold by him after the date of such violation: *Provided*, That such fine shall not exceed $5,000: and notice of such violation shall be served upon the tobacco warehouseman or dealer by mailing the same to him by registered mail or by posting the same at any established place of business operated by him, or both. (7 U. S. C. 1373 (a).)

(b) Farmers engaged in the production of corn, wheat, cotton, rice, peanuts, or tobacco for market shall furnish such proof of their acreage, yield, storage, and marketing of the commodity in the form of records, marketing cards, reports, storage under seal, or otherwise as the Secretary may prescribe as necessary for the administration of this title. (7 U. S. C. 1373 (b).)

(c) All data reported to or acquired by the Secretary pursuant to this section shall be kept confidential by all officers and employees of the Department, and only such data so reported or acquired as the Secretary deems relevant shall be disclosed by them, and then only in a suit or administrative hearing under this title. (7 U. S. C. 1373 (c).)

MEASUREMENT OF FARMS AND REPORT OF PLANTINGS

SEC. 374. (a) The Secretary shall provide, through the county and local committees, for measuring farms on which corn, wheat, cotton, peanuts, or rice is produced and for ascertaining whether the acreage planted for any year to any such commodity is in excess of the farm acreage allotment for such commodity for the farm under this title. If in the case of any farm the acreage planted to any such commodity on the farm is in excess of the farm acreage allotment for such commodity for the farm, the committee shall file with the State committee a written report stating the total acreage on the farm in cultivation and the acreage planted to such commodity. (7 U. S. C. 1374 (a).)

(b) With respect to cotton, the Secretary, upon such terms and conditions as he may by regulation prescribe, shall provide, through the county and local committees for the measurement prior to planting of an acreage on the farm equal to the farm acreage allotment if so requested by the farm operator, and any farm on which the acreage planted to cotton does not exceed such measured acreage shall be deemed to be in compliance with the farm acreage allotment. The Secretary shall similarly provide for the remeasurement upon request by the farm operator of the acreage planted to cotton on the farm, but the operator shall be required to reimburse the local committee for the expense of such remeasurement if the planted acreage is found to be in excess of the allotted acreage. (7 U. S. C. 1374 (b).)

(c) If the acreage determined to be planted to any basic agricultural commodity on the farm is in excess of the farm acreage allotment, the Secretary shall by appropriate regulations provide for a reasonable time prior to harvest within which such planted acreage may be adjusted to the farm acreage allotment. (7 U. S. C. 1374 (c).)

REGULATIONS

SEC. 375. (a) The Secretary shall provide by regulations for the identification, wherever necessary, of corn, wheat, cotton, rice, peanuts, or tobacco so as to afford aid in discovering and identifying such amounts of the commodities as are subject to and such amounts thereof as are not subject to marketing restrictions in effect under this title. (7 U. S. C. 1375 (a).)

(b) The Secretary shall prescribe such regulations as are necessary for the enforcement of this title. (7 U. S. C. 1375 (b).)

COURT JURISDICTION

SEC. 376. The several district courts of the United States are hereby vested with jurisdiction specifically to enforce the provisions of this title. If and when the Secretary shall so request, it shall be the duty of the several district attorneys in their respective districts, under the direction of the Attorney General, to institute proceedings to collect the penalties provided in this title. The remedies and penalties provided for herein shall be in addition to, and not exclusive of, any of the remedies or penalties under existing law. (7 U. S. C. 1376.)

PRESERVATION OF UNUSED ACREAGE ALLOTMENTS

Sec. 377. In any case in which, during any year within the period 1956 to 1959, inclusive, for which acreage planted to a commodity on any farm is less than the acreage allotment for such farm, the entire acreage allotment for such farm (excluding any allotment released from the farm or reapportioned to the farm) shall be considered for purposes of future State, county, and farm acreage allotments to have been planted to such commodity in such year on such farm, but the 1956 acreage allotment of any commodity shall be regarded as planted under this section only if the owner or operator of such farm notified the county committee prior to the sixtieth day preceding the beginning of the marketing year for such commodity of his desire to preserve such allotment. Acreage history credits for released or reapportioned acreage shall be governed by the applicable provisions of this title pertaining to the release and reapportionment of acreage allotments. This section shall not be applicable in any case in which the amount of the commodity required to be stored to postpone or avoid payment of penalty has been reduced because the allotment was not fully planted. (7 U. S. C. 1377.)[50]

Sec. 378. (a) Notwithstanding any other provision of this Act, the allotment determined for any commodity for any land from which the owner is displaced because of acquisition of the land for any purpose, other than for the continued production of allotted crops, by any Federal, State, or other agency having the right of eminent domain shall be placed in an allotment pool and shall be available only for use in providing allotments for other farms owned by the owner so displaced. Upon application to the county committee, within three years after the date of such displacement, or three years after the enactment of this section, whichever period is longer, any

[50] New section 377 substituted by Pub. L. 85–266, 71 Stat. 592, September 2, 1957.

owner so displaced shall be entitled to have established for other farms owned by him allotments which are comparable with allotments determined for other farms in the same area which are similar except for the past acreage of the commodity, taking into consideration the land, labor, and equipment available for the production of the commodity, crop-rotation practices, and the soil and other physical factors affecting the production of the commodity: Provided, That the acreage used to establish or increase the allotments for such farms shall be transferred from the pool and shall not exceed the allotment most recently established for the farm acquired from the applicant and placed in the pool. During the period of eligibility for the making of allotments under this section for a displaced owner, acreage allotments for the farm from which the owner was so displaced shall be established in accordance with the procedure applicable to other farms, and such allotments shall be considered to have been fully planted. After such allotment is made under this section, the proportionate part, or all, as the case may be, of the past acreage used in establishing the allotment most recently placed in the pool for the farm from which the owner was so displaced shall be transferred to and considered for the purposes of future State, county, and farm acreage allotments to have been planted on the farm to which allotment is made under this section. Except where paragraph (c) requires the transfer of allotment to another portion of the same farm, for the purpose of this section (1) that part of any farm from which the owner is so displaced and that part from which he is not so displaced shall be considered as separate farms; and (2) an owner who voluntarily relinquishes possession of the land subsequent to its acquisition by an agency having the right of eminent domain shall be considered as having been displaced because of such acquisition.

(b) The provisions of this section shall not be applicable if (1) there is any marketing quota penalty due with respect to the marketing of the commodity from the farm acquired by the Federal, State, or other agency or by the owner of the farm; (2) any of the commodity produced on such farm has not been accounted for as required by the Secretary; or (3) the allotment next established for the farm acquired by the Federal, State, or other agency would have been reduced because of false or improper identification of the commodity produced on or marketed from such farm or due to a false acreage report.

(c) This section shall not be applicable, in the case of cotton, tobacco, and peanuts, to any farm from which the owner was displaced prior to 1950, in the case of wheat and corn, to any farm from which the owner was displaced prior to 1954, and in the case of rice, to any farm from which the owner was displaced prior to 1955. In any case where the cropland acquired for nonfarming purposes from an owner by an agency having the right of eminent domain represents less than 15 per centum of the total cropland on the farm, the allotment attributable to that portion of the farm so acquired shall be transferred to that portion of the farm not so acquired.

(d) Sections 313 (h), 334 (d), 344 (h), 353 (f), and 358 (h) of the Agricultural Adjustment Act of 1938, as amended, are repealed, but any transfer or reassignment of allotment heretofore made under the provisions of these sections shall remain in effect, and any displaced

farm owner for whom an allotment has been established under such repealed sections shall not be eligible for additional allotment under subsection (a) of this section because of such displacement.[51] *(7 U. S. C. 1378.)*

SUBTITLE D—RICE CERTIFICATES

LEGISLATIVE FINDINGS

SEC. 380a. to SEC. 380p. Applicable only to 1956, 1957 and 1958 crops of rice.

SUBTITLE E—MISCELLANEOUS PROVISIONS AND APPROPRIATIONS

PART I—MISCELLANEOUS

COTTON PRICE ADJUSTMENT PAYMENTS

SEC. 381. (a) (Applicable only to 1937 crop of cotton.)
(b) (Applicable only to 1937 crop of cotton.)
(c) (Repealed by 62 Stat. 1255.)
SEC. 382. (Applicable only to 1937 crop of cotton.)

INSURANCE OF COTTON AND RECONCENTRATION OF COTTON

SEC. 383. (a) The Commodity Credit Corporation shall place all insurance of every nature taken out by it on cotton, and all renewals, extensions, or continuations of existing insurance, with insurance agents who are bona fide residents of and doing business in the State where the cotton is warehoused: *Provided*, That such insurance may be secured at a cost not greater than similar insurance offered on said cotton elsewhere. (7 U. S. C. 1383 (a).)

(b) Cotton held as security for any loan heretofore or hereafter made or arranged for by the Commodity Credit Corporation shall not hereafter be reconcentrated without the written consent of the producer or borrower. (7 U. S. C. 1383 (b).)

[ACT OF JUNE 16, 1938.—In the administration of section 383 (b) of the Agricultural Adjustment Act of 1938 the written consent of the producer or borrower to the reconcentration of any cotton held as security for any loan heretofore or hereafter made or arranged for by the Commodity Credit Corporation shall not be deemed to have been given unless such consent shall have been given in an instrument made solely for that purpose. Notwithstanding any provision of any loan agreement heretofore made, no cotton held under any such agreement as security for any such loan shall be moved from one warehouse to another unless the written consent of the producer or borrower shall have been obtained in a separate instrument given solely for that purpose, as required by this Act. The giving of written consent for the reconcentration of cotton shall not be made a condition upon the making of any loan hereafter made or arranged for by the Commodity Credit Corporation: *Provided, however*, That in cases where there is congestion and lack of storage facilities, and the local warehouse certifies such fact and requests the Commodity Credit Corporation to

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[51] New section 378 added by Pub. L. 85–835, 72 Stat. 995, August 28, 1958.

move the cotton for reconcentration to some other point, or when the Commodity Credit Corporation determines such loan cotton is improperly warehoused and subject to damage, or if uninsured, or if any of the terms of the loan agreement are violated, or if carrying charges are substantially in excess of the average of carrying charges available elsewhere, and the local warehouse, after notice, declines to reduce such charges, such written consent as provided in this amendment need not be obtained; and consent to movement under any of the conditions of this proviso may be required in future loan agreements. (58 Stat. 762, 7 U. S. C. 1383a.)]

REPORT OF BENEFITS

SEC. 384. (Repealed by 60 Stat. 866, Aug. 7, 1946.)

FINALITY OF FARMERS' PAYMENTS AND LOANS

SEC. 385. The facts constituting the basis for any Soil Conservation Act payment, parity payment, loan, or price support operation, or the amount thereof, when officially determined in conformity with the applicable regulations prescribed by the Secretary or by the Commodity Credit Corporation, shall be final and conclusive and shall not be reviewable by any other officer or agency of the Government. In case any person who is entitled to any such payment dies, becomes incompetent, or disappears before receiving such payment, or is succeeded by another who renders or completes the required performance, the payment shall, without regard to any other provisions of law, be made as the Secretary of Agriculture may determine to be fair and reasonable in all the circumstances and provide by regulations. (7 U. S. C. 1385.)

SEC. 386. The provisions of section 3741 of the Revised Statutes (U. S. C., 1934 edition, title 41, sec. 22) and sections 114 and 115 of the Criminal Code of the United States (U. S. C., 1934 edition, title 18, secs. 204 and 205) [now 18 U. S. C. 431 and 432] shall not be applicable to loans or payments made under this Act (except under section 383 (a)). (7 U. S. C. 1386.)

PHOTOGRAPHIC REPRODUCTIONS AND MAPS

SEC. 387. The Secretary may furnish reproductions of such aerial or other photographs, mosaics, and maps as have been obtained in connection with the authorized work of the Department to farmers and governmental agencies at the estimated cost of furnishing such reproductions, and to persons other than farmers at such prices (not less than estimated cost of furnishing such reproductions) as the Secretary may determine, the money received from such sales to be deposited in the Treasury to the credit of the appropriation charged with the cost of making such reproductions. This section shall not affect the power of the Secretary to make other disposition of such or similar materials under any other provisions of existing law. (7 U. S. C. 1387.)

UTILIZATION OF LOCAL AGENCIES

SEC. 388. (a) The provisions of section 8 (b) and section 11 of the Soil Conservation and Domestic Allotment Act, as amended, relating

to the utilization of State, county, local committees, the extension service, and other approved agencies, and to recognition and encouragement of cooperative associations, shall apply in the administration of this Act; and the Secretary shall, for such purposes, utilize the same local, county, and State committees as are utilized under sections 7 to 17, inclusive, of the Soil Conservation and Domestic Allotment Act, as amended. The local administrative areas designated under section 8 (b) of the Soil Conservation and Domestic Allotment Act, as amended, for the administration of programs under that Act, and the local administrative areas designated for the administration of this Act shall be the same. (7 U. S. C. 1388 (a).)

(b) The Secretary is authorized and directed, from any funds made available for the purposes of the Acts in connection with which county committees are utilized, to make payments to county committees of farmers to cover the estimated administrative expenses incurred or to be incurred by them in cooperating in carrying out the provisions of such Acts. All or part of such estimated administrative expenses of any such committee may be deducted pro rata from the Soil Conservation Act payments, parity payments, or loans, or other payments under such Acts, made unless payment of such expenses is otherwise provided by law. The Secretary may make such payments to such committees in advance of determination of performance by farmers. (7 U. S. C. 1388 (b).)

PERSONNEL

SEC. 389. The Secretary is authorized and directed to provide for the execution by the Agricultural Adjustment Administration of such of the powers conferred upon him by this Act as he deems may be appropriately exercised by such administration; and for such purposes the provisions of law applicable to appointment and compensation of persons employed by the Agricultural Adjustment Administration shall apply. (7 U. S. C. 1389.) [52]

SEPARABILITY

SEC. 390. If any provision of this Act, or the application thereof to any person or circumstance, is held invalid, the validity of the remainder of the Act and the application of such provision to other persons or circumstances, and the provisions of the Soil Conservation and Domestic Allotment Act, as amended, shall not be affected thereby. Without limiting the generality of the foregoing, if any provision of this Act should be held not to be within the power of the Congress to regulate interstate and foreign commerce, such provision shall not be held invalid if it is within the power of the Congress to provide for the general welfare or any other power of the Congress. If any provision of this Act for marketing quotas with respect to any commodity should be held invalid, no provision of this Act for marketing quotas with respect to any other commodity shall be affected thereby. If the application of any provision for a referendum should be held invalid, the application of other provisions shall not be affected

[52] The functions of the Agricultural Adjustment Administration were transferred to the Secretary of Agriculture by 1946 Reorganization Plan No. 3 (60 Stat. 1100, 11 F. R. 7877), and delegated by him to the Commodity Stabilization Service (19 F. R. 77).

thereby. If by reason of any provision for a referendum the application of any such other provision to any person or circumstance is held invalid, the application of such other provision to other persons or circumstances shall not be affected thereby. (7 U. S. C. 1390.)

PART II—APPROPRIATIONS AND ADMINISTRATIVE EXPENSES

APPROPRIATIONS

SEC. 391. (a) Beginning with the fiscal year ending June 30, 1938, there is hereby authorized to be appropriated, for each fiscal year for the administration of this Act and for the making of soil conservation and other payments such sums as Congress may determine, in addition to any amount made available pursuant to section 15 of the Soil Conservation and Domestic Allotment Act, as amended. (7 U. S. C. 1391 (a).)

(b) (Applicable only to fiscal year 1938.)

(c) During each fiscal year, beginning with the fiscal year ending June 30, 1941, the Commodity Credit Corporation is authorized and directed to loan to the Secretary such sums, not to exceed $50,000,000, as he estimates will be required during such fiscal year, to make crop insurance premium advances and to make advances pursuant to the applicable provisions of sections 8 and 12 of the Soil Conservation and Domestic Allotment Act, as amended, in connection with programs applicable to crops harvested in the calendar year in which such fiscal year ends, and to pay the administrative expenses of county agricultural conservation associations for the calendar year in which such fiscal year ends. The sums so loaned during any fiscal year shall be transferred to the current appropriation available for carrying out sections 7 to 17 of such Act and shall be repaid, with interest at a rate to be determined by the Secretary but not less than the cost of money to the Commodity Credit Corporation for a comparable period, during the succeeding fiscal year from the appropriation available for that year or from any unobligated balance of the appropriation for any other year. (7 U. S. C. 1391 (c).)

ADMINISTRATIVE EXPENSES

SEC. 392. (a) The Secretary is authorized and directed to make such expenditures as he deems necessary to carry out the provisions of this Act and sections 7 to 17, inclusive, of the Soil Conservation and Domestic Allotment Act, as amended, including personal services and rents in the District of Columbia and elsewhere; traveling expenses; supplies and equipment; lawbooks, books of reference, directories, periodicals, and newspapers; and the preparation and display of exhibits, including such displays at community, county, State, interstate, and international fairs within the United States. The Secretary of the Treasury is authorized and directed upon the request of the Secretary to establish one or more separate appropriation accounts into which there shall be transferred from the respective funds available for the purposes of the several Acts, in connection with which personnel or other facilities of the Agricultural Adjustment Adminis-

tration are utilized, proportionate amounts estimated by the Secretary to be required by the Agricultural Adjustment Administration for administrative expenses in carrying out or cooperating in carrying out any of the provisions of the respective Acts. (7 U. S. C. 1392 (a).)

(b) In the administration of this title and sections 7 to 17, inclusive, of the Soil Conservation and Domestic Allotment Act, as amended, the aggregate amount expended in any fiscal year, beginning with the fiscal year ending June 30, 1942, for administrative expenses in the District of Columbia, including regional offices, and in the several States (not including the expenses of county and local committees) shall not exceed 3 per centum of the total amount available for such fiscal year for carrying out the purposes of this title and such Act, unless otherwise provided by appropriation or other law. In the administration of section 32 of the Act entitled "An Act to amend the Agricultural Adjustment Act, and for other purposes," approved August 24, 1935 (49 Stat. 774), as amended, and the Agricultural Marketing Agreement Act of 1937, as amended, and those sections of the Agricultural Adjustment Act (of 1933), as amended, which were reenacted and amended by the Agricultural Marketing Agreement Act of 1937, as amended, the aggregate amount expended in any fiscal year, beginning with the fiscal year ending June 30, 1942, for administrative expenses in the District of Columbia, including regional offices, and in the several States (not including the expenses of county and local committees) shall not exceed 4 per centum of the total amount available for such fiscal year for carrying out the purposes of said Acts, unless otherwise provided by appropriation or other law. In the event any administrative expenses of any county or local committee are deducted in any fiscal year, beginning with the fiscal year ending June 30, 1939, from Soil Conservation Act payments, parity payments, or loans, each farmer receiving benefits under such provisions shall be apprised of the amount or percentage deducted from such benefit payment or loan on account of such administrative expenses. The names and addresses of the members and employees of any county or local committee, and the amount of such compensation received by each of them, shall be posted annually in a conspicuous place in the area within which they are employed. (7 U. S. C. 1392 (b).)

ALLOTMENT OF APPROPRIATIONS

SEC. 393. All funds for carrying out the provisions of this Act shall be available for allotment to bureaus and offices of the Department, and for transfer to such other agencies of the Federal Government, and to such State agencies, as the Secretary may request to cooperate or assist in carrying out the provisions of this Act. (7 U. S. C. 1393.)

TITLE IV—COTTON POOL PARTICIPATION TRUST CERTIFICATES

[The provisions of this title have not been repealed but are no longer applicable. (7 U. S. C. 1401–1407.)]

SOIL BANK ACT

EXPLANATORY NOTE

The Soil Bank Act, which was enacted as title I of the Agricultural Act of 1956 (70 Stat. 188), authorized assistance to farmers to divert a portion of their cropland from the production of excessive supplies of agricultural commodities, and to carry out a program of soil, water, forest, and wildlife conservation.

PART III

SOIL BANK ACT [1]

SHORT TITLE

SEC. 101. This title may be cited as the "Soil Bank Act". (7 U. S. C. 1801 note.)

DECLARATION OF POLICY

SEC. 102. The Congress hereby finds that the production of excessive supplies of agricultural commodities depresses the prices and income of farm families; constitutes improper land use and brings about soil erosion, depletion of soil fertility, and too rapid release of water from lands where it falls, thereby adversely affecting the national welfare, impairing the productive facilities necessary for a continuous and stable supply of agricultural commodities, and endangering an adequate supply of water for agricultural and nonagricultural use; overtaxes the facilities of interstate and foreign transportation; congests terminal markets and handling and processing centers in the flow of commodities from producers to consumers; depresses prices in interstate and foreign commerce; disrupts the orderly marketing of commodities in such commerce; and otherwise affects, burdens, and obstructs interstate and foreign commerce. It is in the interest of the general welfare that the soil and water resources of the Nation be not wasted and depleted in the production of such burdensome surpluses and that interstate and foreign commerce in agricultural commodities be protected from excessive supplies. It is hereby declared to be the policy of the Congress and the purposes of this title to protect and increase farm income, to protect the national soil, water, and forest and wildlife resources from waste and depletion, to protect interstate and foreign commerce from the burdens and obstructions which result from the utilization of farmland for the production of excessive supplies of agricultural commodities, and to provide for the conservation of such resources and an adequate, balanced, and orderly flow of such agricultural commodities in interstate and foreign commerce. To effectuate the policy of Congress and the purposes of this title programs are herein authorized to assist farmers to divert a portion of their cropland from the production of excessive supplies of agricultural commodities, and to carry out a program of soil, water, forest and wildlife conservation. The activities authorized under this title are supplementary to the acreage allotments and marketing quotas authorized under the Agricultural Adjustment Act of 1938, as amended, and together with such acreage allotments and marketing quotas, constitute an over-all program to prevent excessive supplies of agricultural commodities from burdening and obstructing interstate and foreign commerce. (7 U. S. C. 1801.)

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[1] Approved May 18, 1956, 70 Stat. 188.

SUBTITLE A—ACREAGE RESERVE PROGRAM

TERMS AND CONDITIONS

SEC. 103. (a) Notwithstanding any other provision of law, the Secretary of Agriculture (hereinafter referred to as the "Secretary") is authorized and directed to formulate and carry out an acreage reserve program for the 1956, 1957, 1958, and 1959 [2] crops of wheat,[3] cotton, corn produced in the commercial corn-producing area, peanuts, rice, flue-cured tobacco, burley tobacco, Maryland tobacco, dark air-cured tobacco, fire-cured tobacco, Virginia sun-cured tobacco, cigar binder tobacco types 51, 52, 54, and 55, Ohio cigar filler tobacco types 42, 43, and 44, respectively (hereinafter referred to as "the commodity"), under which producers shall be compensated for reducing their acreages of the commodity below their farm acreage allotments or their farm base acreages, whichever may be applicable. To be eligible for such compensation the producer (1) shall reduce his acreage of the commodity below his farm acreage allotment or farm base acreage, whichever may be applicable, within such limits as the Secretary may prescribe, (2) shall specifically designate the acreage so withdrawn from the production of such commodity (hereinafter referred to as the "reserve acreage"), and (3) shall not harvest any crop from, or graze, the reserve acreage unless the Secretary, after certification by the Governor of the State in which such acreage is situated of the need for grazing on such acreage, determines that it is necessary to permit grazing thereon in order to alleviate damage, hardship, or suffering caused by severe drought, flood, or other natural disaster, and consents to such grazing. Reserve acreage of a commodity may include acreage whether or not planted to the production of the 1956 crop of the commodity prior to the announcement of the acreage reserve program for the 1956 crop if the crop thereon, if any, shall be plowed under or otherwise physically incorporated into the soil, or clipped, mowed, or cut to prevent maturing so that the reduction in acreage of the commodity below the acreage allotment occurs not later than 21 days after the enactment of this title, or by such later date as may be fixed by the Secretary. The reserve acreage shall be in addition to any acreage devoted to the conservation reserve program authorized under subtitle B of this title. The acreage reserve program may include such terms and conditions, in addition to those specifically provided for herein, including provisions relating to control of noxious weeds on the reserve acreage, as the Secretary determines are desirable to effectuate the purposes of this title and to facilitate the practical administration of the acreage reserve program.

Before any producer is entitled to receive any compensation for participating in the acreage reserve program, he must first enter into a contract with the Secretary, which contract, in addition to such other terms and conditions as may be prescribed by the Secretary, shall contain provisions by which such producer shall agree:

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[2] See the provision of the 1959 Agriculture Appropriation Act (p. 252) prohibiting any expenditure thereunder for an acreage reserve program with respect to 1959 crops.

[3] Pub. L. 85–13 (p. 50) and Pub. L. 85–390 (p. 52) amended section 334 of the Agricultural Adjustment Act of 1938 to add provisions relating to participation in the acreage reserve program by producers receiving increased allotments for durum wheat.

(i) In the event that the Secretary determines that there has been a violation of the contract at any stage during the time such producer has control of the farm and that such violation is of such a substantial nature as to warrant termination of the contract, to forfeit all rights to payments or grants under the contract, and to refund to the United States all payments and grants received by him thereunder: *Provided, however*, That the provisions of Section 107 (d) shall apply to the termination of any contract hereunder.

(ii) In the event that the Secretary determines that there has been a violation of the contract but that such violation is of such a nature as not to warrant termination of the contract, to accept such payment adjustments, forfeit such benefits, and make such refunds to the United States of payments and benefits received by him, under the contract, as the Secretary may determine to be appropriate. (7 U. S. C. 1821 (a).)

(b) (1) There is hereby established for 1956 and for each year for which an acreage reserve program is in effect for corn a total base acreage of corn for the commercial corn-producing area proclaimed under section 327 of the Agricultural Adjustment Act of 1938, as amended, of fifty-one million acres. The total base acreage of corn for the commercial corn-producing area shall be apportioned by the Secretary among the counties in such area on the basis of the acreage of corn in such counties during the five calendar years immediately preceding the calendar year in which the apportionment is made (plus, in applicable years, the acreage diverted under previous agricultural adjustment, conservation, and soil bank programs), with adjustments for abnormal weather conditions, for trends in acreage during such period and for the promotion of soil-conservation practices: *Provided*, That any downward adjustment for the promotion of soil-conservation practices shall not exceed 2 per centum of the total base acreage that would otherwise be apportioned to the county. The base acreage for the county shall be apportioned by the Secretary, through the local committees, among the farms within the county on the basis of past acreage of corn (planted and diverted), tillable acreage crop-rotation practices, types of soil, and topography.

(2) This subsection (b) shall become inoperative after 1956 if in the referendum conducted pursuant to section 308 (b),[4] producers do not vote in favor of the program provided in subsection (c) of such section. (7 U. S. C. 1821 (b).)

EXTENT OF PARTICIPATION IN PROGRAM

SEC. 104. For purposes of the acreage reserve program the Secretary shall establish a national reserve acreage goal for the 1956, 1957, 1958, and 1959 crops of each commodity specified in section 103 (a). The limits within which individual farms may participate in the acreage reserve program shall be established in such manner as the Secretary determines is reasonably calculated to achieve the national reserve acreage goal and give producers a fair and equitable opportunity to participate in the acreage reserve program, taking into consideration their acreage allotments or farm base acreages, whichever may be applicable, the supply and demand conditions for different classes,

[4] Subsec. (b) is inoperative since the corn producers voting in this referendum voted against the price support program provided in sec. 308 (c) of the Agricultural Act of 1956.

grades, and qualities of the commodity, and such other factors as he deems appropriate. (7 U. S. C. 1822.)

COMPENSATION OF PRODUCERS

SEC. 105. (a) Producers shall be compensated for participating in the acreage reserve program through the issuance of negotiable certificates which the Commodity Credit Corporation shall redeem in accordance with regulations prescribed by the Secretary (1) in cash upon presentation by the producer or by any holder in due course or (2) at the option of the producer in the case of certificates issued with respect to grains and upon presentation by him, in grains (such grains to be valued by the Secretary at such levels as he determines will not materially impair the market price for such grain yet will, to the maximum extent practicable encourage acceptance of payment in grains in lieu of cash): *Provided*, That disposition of quantities of stocks hereunder in any one year shall be limited to not more than two-thirds of such quantities of such commodities as the Secretary determines would be a reasonable estimate of what would have been produced for marketing during such marketing year on the acreage withheld from production under the provisions of this title: *And provided further*, That such stocks shall not be released prior to the end of the normal harvesting season for the particular commodity being released. Compensation under this section shall be at such rate or rates as the Secretary determines will provide producers with a fair and reasonable return for reducing their acreage of the commodity, taking into consideration the loss of production of the commodity on the reserve acreage, any savings in cost which result from not planting the commodity on the reserve acreage, and the incentive necessary to achieve the reserve acreage goal. The Secretary shall make an adjustment in yields for drought, flood, or other abnormal conditions in estimating the loss of production for purposes of establishing rates of compensation. The rates of payment offered under this section shall be such as to encourage producers to underplant their allotments more than one year. Commodities delivered to producers in redemption of such certificates shall not be eligible for tender to Commodity Credit Corporation under the price support program. (7 U. S. C. 1823 (a).)

(b) Compensation shall be paid to any producer for participating in the acreage reserve program for any year including 1956 when the Secretary has ascertained that such producer has complied with the acreage reduction requirements of such program for such year. (7 U. S. C. 1823 (b).)

(c) The total compensation paid producers for participating in the acreage reserve program with respect to any year's crops shall not exceed $750,000,000, and with respect to any commodity for any year shall not exceed the amount shown below: Wheat, $375,000,000; cotton, $300,000,000; corn in the commercial corn-producing area, $300,000,000; peanuts, $7,000,000; rice, $23,000,000; and tobacco, $45,000,000. The total amount available for the acreage reserve program for any year's crops shall be apportioned among the various commodities on the basis of the amounts required to achieve the reserve acreage goal for each commodity established under section 104. (7 U. S. C. 1823 (c).)

EFFECT ON ACREAGE ALLOTMENTS AND QUOTAS

Sec. 106. (a) In the future establishment of State, county, and farm acreage allotments under the Agricultural Adjustment Act of 1938, as amended, or base acreages under this title, reserve acreages applicable to any commodity shall be credited to the State, county, and farm as though such acreage had actually been devoted to the production of the commodity. (7 U. S. C. 1824 (a).)

(b) In applying the provisions of paragraph (6) of Public Law 74, Seventy-seventh Congress (7 U. S. C. 1340 (6)), and sections 326 (b) and 356 (g) of the Agricultural Adjustment Act of 1938, as amended (7 U. S. C. 1326 (b), 1356 (g)), relating to reduction of the storage amounts of wheat and rice, the reserve acreage of the commodity on any farm shall be regarded as wheat acreage or rice acreage, as the case may be, on the farm. (7 U. S. C. 1824 (b).)

Subtitle B—Conservation Reserve Program

TERMS AND CONDITIONS

Sec. 107. (a) To effectuate the purposes of this title the Secretary is hereby authorized to enter into contracts for periods of not less than three years with producers determined by him to have control for the contract period of the farms covered by the contract wherein the producer shall agree:

(1) To establish and maintain for the contract period protective vegetative cover (including but not limited to grass and trees), water storage facilities, or other soil-, water-, wildlife-, or forest-conserving uses on a specifically designated acreage of land on the farm regularly used in the production of crops (including crops, such as tame hay, alfalfa, and clovers, which do not require annual tillage).

(2) To devote to conserving crops or uses, or allow to remain idle, throughout the contract period an acreage of the remaining land on the farm which is not less than the acreage normally devoted only to conserving crops or uses or normally allowed to remain idle on such remaining acreage.

(3) Not to harvest any crop from the acreage established in protective vegetative cover, excepting timber (in accordance with sound forestry management) and wildlife or other natural products of such acreage which do not increase supplies of feed for domestic animals.

(4) Not to graze any acreage established in protective vegetative cover prior to January 1, 1959, or such later date as may be provided in the contract, except pursuant to the provisions of section 103 (a) (3) hereof; and if such acreage is grazed at the end of such period, to graze such acreage during the remainder of the period covered by the contract in accordance with sound pasture management.

(5) Not to adopt any practice, or divert lands on the farm from conservation, woods, grazing, or other use, to any use specified by the Secretary in the contract as a practice or use which would tend to defeat the purposes of the contract.

(6) (A) In the event that the Secretary determines that there has been a violation of the contract (including the prohibition of grazing

on conservation acreages) at any stage during the time such producer has control of the farm and that such violation is of such a substantial nature as to warrant termination of the contract, to forfeit all rights to payments or grants under the contract, and to refund to the United States all payments and grants received by him thereunder.

(B) In the event that the Secretary determines that there has been a violation of the contract but that such violation is of such a nature as not to warrant termination of the contract, to accept such payment adjustments, forfeit such benefits, and make such refunds to the United States of payments and benefits received by him, under the contract, as the Secretary may determine to be appropriate.

(7) To such additional provisions as the Secretary determines are desirable and includes in the contract to effectuate the purposes of this title and to facilitate the practical administration of the conservation reserve program, including provisions relating to control of noxious weeds. (7 U. S. C. 1831 (a).)

(b) In return for such agreement by the producer the Secretary shall agree:

(1) To bear such part of the cost (including labor) of establishing and maintaining vegetative cover or water storage facilities, or other soil-, water-, wildlife-, or forest-conserving uses, on the designated acreage as the Secretary determines to be necessary to effectuate the purposes of this title, but not to exceed a maximum amount per acre or facility prescribed by the Secretary for the county or area in which the farm is situated; [5] and

(2) To make an annual payment to the producer for the term of the contract upon determination that he has fulfilled the provisions of the contract entitling him to such payment. The rate or rates of the annual payment to be provided for in the contracts shall be established on such basis as the Secretary determines will provide producers with a fair and reasonable annual return on the land established in protective vegetative cover or water storage facilities, or other soil-, water-, wildlife-, or forest-conserving uses, taking into consideration the value of the land for the production of commodities customarily grown on such kind of land in the county or area, the prevailing rates for cash rentals for similar land in the county or area, the incentive necessary to obtain contracts covering sufficient acreage for the substantial accomplishment of the purposes of the conservation reserve program, and such other factors as he deems appropriate.[5] Such rate or rates may be determined on an individual farm basis, a county or area basis, or such other basis as the Secretary determines will facilitate the practical administration of the program. (7 U. S. C. 1831 (b).)

(c) In determining the lands in any area to be covered by contracts entered into under this section, the Secretary may use advertising and bid procedure if he determines that such action will contribute to the effective and equitable administration of the conservation reserve program. (7 U. S. C. 1831 (c).)

(d) A contract shall not be terminated under paragraph (6) of subsection (a) unless the nature of the violation is such as to defeat or substantially impair the purposes of the contract. Whenever the

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[5] See the 1959 agriculture appropriation act which contains limitations on payments to producers under the conservation reserve program (p. 252).

State committee believes that there has been a violation which would warrant termination of a contract, the producer shall be given written notice thereof by registered mail or personal service, and the producer shall, if he requests such an opportunity within thirty days after the delivery or service of such notice, be given an opportunity to show cause, in an informal proceeding before the county committee under regulations promulgated by the Secretary, why the contract should not be terminated. If the producer does not request an opportunity to show cause why the contract should not be terminated within such thirty-day period, the determination of the State committee made in accordance with regulations of the Secretary shall be final and conclusive. If the producer within such thirty-day period requests an opportunity to show cause why the contract should not be terminated, the county committee, at the conclusion of the proceeding, shall submit a report, including its recommendations, to the State committee for a determination, on the basis of such report and such other information as is available to the State committee, as to whether there has been a violation which would warrant termination of the contract. The producer shall be accorded the right, in accordance with regulations promulgated by the Secretary, to appear before the State committee in connection with the State committee's determination of the issue. The producer shall be given written notice by registered mail or personal service of the State committee's determination. If the producer feels aggrieved by such determination, he may obtain judicial review of such determination by filing a complaint with the United States district court for the district in which the land covered by the contract is located, within ninety days after the delivery or service of notice of such determination, requesting the court to set aside such determination. Service of process in such action shall be made in accordance with the rule for service of process upon the United States prescribed by the Rules of Civil Procedure for the United States District Courts. The copy of the summons and complaint required to be delivered to the officer or agency whose order is being attacked shall be sent to the chairman of the State committee. The action in the United States district court shall be a trial de novo to determine whether there has been a violation which would warrant termination of the contract. If the producer does not seek judicial review of the State committee's determination within the ninety-day period allowed therefor, the State committee's determination shall be final and conclusive. The terms "county committee" and "State committee" as used herein refer to the county and State committees established under section 8 of the Soil Conservation and Domestic Allotment Act, as amended. (7 U. S. C. 1831 (d).)

CONSERVATION RESERVE GOAL

SEC. 108. (a) The Secretary shall not later than February 1 of each year determine and announce the national conservation reserve goal for such year. Such goal shall be that percentage which the Secretary determines it is practicable to cover by contracts during such year of the number of acres, if any, by which (1) the acreage used for the production of agricultural commodities during the year preceding the

year for which such determination is made, plus any acreage then in the acreage or conservation reserve program or retired from production as a result of acreage allotments or marketing quotas, exceeds (2) the acreage needed during the year for which such determination is made for the production of agricultural commodities for domestic consumption and export and an adequate allowance for carryover. As soon as practicable after the enactment of this title the Secretary shall determine the national conservation acreage goal for 1956. (7 U. S. C. 1832 (a).)

(b) In distributing the national acreage goal among the various States and major crop production regions, the Secretary shall give due regard to the respective needs of the various States and regions for flood control, drought control, and other conservation benefits; the desires of producers in particular States or regions to participate in the conservation program; the diversion of acreage from crops under acreage allotments or marketing quotas; and the need to assure adequate production of agricultural commodities and products not in surplus and to discourage the production of agricultural commodities and products in surplus. (7 U. S. C. 1832 (b).)

(c) The Secretary shall transmit to the Congress on or before March 15 of each year a report of the scope of the conservation reserve program for the preceding year and the basis for participation in such program in the various States and major crop production regions of the country. (7 U. S. C. 1832 (c).)

AUTHORIZED PERIOD OF CONTRACTS AND EXPENDITURES

SEC. 109. (a) The Secretary is authorized to formulate and announce programs under this subtitle B and to enter into contracts thereunder with producers during the five-year period 1956–1960 to be carried out during the period ending not later than December 31, 1969, except that contracts for the establishment of tree cover may continue until December 31, 1974. (7 U. S. C. 1833 (a).)

(b) The period covered by any contract shall not exceed ten years, except that contracts for the establishment of tree cover may extend for 15 years. (7 U. S. C. 1833 (b).)

(c) In carrying out the conservation reserve program, the Secretary shall not enter into contracts with producers which would require payments to producers, including the cost of materials and services, in excess of $450,000,000 in any calendar year. (7 U. S. C. 1833 (c).)

TERMINATION AND MODIFICATION OF CONTRACTS

SEC. 110. (a) The Secretary may terminate any contract with a producer by mutual agreement with the producer if the Secretary determines that such termination would be in the public interest. (7 U. S. C. 1834 (a).)

(b) The Secretary may agree to such modification of contracts previously entered into as he may determine to be desirable to carry out the purposes of this title and to facilitate the practical administration of the conservation reserve program. (7 U. S. C. 1834 (b).)

CONSERVATION MATERIALS AND SERVICES

SEC. 111. (a) The Secretary may purchase or produce conservation materials and services and make such materials and services available

to producers under the conservation reserve program to aid them in establishing vegetative cover or water storage facilities, or other soil-, water-, wildlife-, or forest-conserving uses, under contracts authorized by this subtitle B, may reimburse any Federal, State, or local government agency for conservation materials and services furnished by such agency, and may pay expenses necessary in making such materials, and services available, including all or part of the costs incident to the delivery, application, or installation of materials and services. (7 U. S. C. 1835 (a).)

(b) Notwithstanding any other provision of law, in making conservation materials and services available to producers hereunder, the Secretary may make payments, in advance of determination of performance by the producers, to persons who fill purchase orders covering approved conservation materials or who render services to the Secretary in furnishing to producers approved conservation materials or services for the establishment by the producers of vegetative cover or water storage facilities, or other soil-, water-, wildlife-, or forest-conserving uses, under contracts authorized by this subtitle B. The price at which purchase orders for any conservation material or service are filled may be limited, if the Secretary determines that it is necessary in the interest of producers and the Government, to a fair price fixed in accordance with regulations prescribed by the Secretary. (7 U. S. C. 1835 (b).)

EFFECT ON OTHER PROGRAMS

SEC. 112. Notwithstanding any other provision of law—

(1) insofar as the acreage of cropland on any farm enters into the determination of acreage allotments and marketing quotas under the Agricultural Adjustment Act of 1938, as amended, the cropland acreage on the farm shall not be deemed to be decreased during the period of any contract entered into under the conservation reserve program by reason of the establishment and maintenance of vegetative cover or water storage facilities, or other soil-, water-, wildlife-, or forest-conserving uses, under such contract; and

(2) the acreage on any farm which is determined under regulations of the Secretary to have been diverted from the production of any commodity in order to carry out the contract entered into under the conservation reserve program shall be considered acreage devoted to the commodity for the purposes of establishing future State, county, and farm acreage allotments under the Agricultural Adjustment Act of 1938, as amended, and base acreages under this Act. (7 U. S. C. 1836.)

GEOGRAPHICAL APPLICABILITY

SEC. 113. This subtitle B shall apply to the continental United States, and, if the Secretary determines it to be in the national interest, to one or more of the Territories of Alaska and Hawaii, the Commonwealth of Puerto Rico, and the Virgin Islands, and as used in this subtitle B, the term "State" includes Alaska, Hawaii, Puerto Rico, and the Virgin Islands. (7 U. S. C. 1837.)

Subtitle C—General Provisions

COMPLIANCE WITH ACREAGE ALLOTMENTS

Sec. 114. No person shall be eligible for payments or compensation under this title with respect to any farm for any year in which (1) the acreage of any basic agricultural commodity other than wheat or corn on the farm exceeds the farm acreage allotment for the commodity under title III of the Agricultural Adjustment Act of 1938, as amended, or (2) in the case of a farm which is not exempted from marketing quota penalties under section 335 (f) of the Agricultural Adjustment Act of 1938, as amended, the wheat acreage on the farm exceeds the larger of the farm wheat acreage allotment under such title or fifteen acres, or [6] (3) the corn acreage on the farm, in the case of a farm in the commercial corn-producing area, exceeds the farm base acreage for corn or the farm acreage allotment, whichever is in effect. For the purpose of this section, a producer shall not be deemed to have exceeded his farm acreage allotment or farm base acreage, unless such producer knowingly exceeded such allotment or base acreage and, in the case of wheat, unless such producer knowingly exceeded the farm acreage allotment of fifteen acres, whichever is larger.

Notwithstanding any other provision of this section—(1) no person shall be ineligible to receive payments or compensation under an acreage reserve contract for 1958 by reason of the fact that the corn acreage on the farm exceeds the farm acreage allotment for corn if the county in which such farm is located is included in the commercial corn producing area for the first time in 1958; (2) no person shall be ineligible to receive payments or compensation under an acreage reserve contract for any year subsequent to 1958 or a conservation reserve contract by reason of the fact that the corn acreage on the farm exceeds the farm acreage allotment for corn if such contract was entered into prior to January 1 of the first year for which the county is included in the commercial corn producing area: *Provided*, That the foregoing provisions of this sentence shall apply only to a farm for which an "old farm" corn allotment is established for such first year. For purposes of this provision, a contract which has been terminated by the producer under the program regulations by reason of the fact that the county in which the farm is located was included in the commercial corn-producing area for the first time in 1958, and which is reinstated, shall be deemed to have been entered into as of the original date of execution of such contract.[7] (7 U. S. C. 1802.)

REAPPORTIONMENT PROHIBITED

Sec. 115. No acreage diverted from the production of any commodity subject to acreage allotments as a result of participation in the acreage reserve or conservation reserve programs shall be reapportioned or allotted to any other farm. (7 U. S. C. 1803.)

CERTIFICATE OF CLAIMANT

Sec. 116. Subject to the provisions of section 105 (b), payment or compensation authorized by this title may be made upon the certifi-

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[6] Subdivision (2) of sec. 114 amended by Pub. L. 85–203, 71 Stat. 478, August 28, 1957.
[7] The preceding two sentences were added by Pub. L. 85–369, 72 Stat. 81, April 7, 1958.

cate of the claimant, in such form, as the Secretary may prescribe, that he has complied with all requirements for such payment and that the statements and information contained in the application for payment are correct and true, to the best of his knowledge and belief. (7 U. S. C. 1804.)

UTILIZATION OF LOCAL AND STATE COMMITTEES

SEC. 117. In administering this title in the continental United States, the Secretary shall utilize the services of local, county, and State committees established under section 8 of the Soil Conservation and Domestic Allotment Act, as amended. (7 U. S. C. 1805.)

UTILIZATION OF OTHER AGENCIES

SEC. 118. With respect to conservation aspects of any program under this title, the Secretary shall consult with the soil-conservation districts, State foresters, State game and fish agencies, land-grant colleges, and other appropriate agencies of State governments, and with the Fish and Wildlife Service, in the formulation of program provisions at the State and county levels. The technical resources of the Soil Conservation Service, the Forest Service, the land-grant colleges, the State foresters, State game and fish agencies, the Fish and Wildlife Service, and other appropriate technical services shall be utilized, so far as practicable, to assure coordination of conservation activities and a solid technical foundation for the program. (7 U. S. C. 1806.)

UTILIZATION OF LAND USE CAPABILITY DATA

SEC. 119. In administering this title the Secretary shall utilize to the fullest practicable extent land use capability data, including capability surveys as developed by the Soil Conservation Service, and shall carry forward to completion as rapidly as possible the basic land inventory of the Nation. (7 U. S. C. 1807.)

FINANCING

SEC. 120. (a) The Secretary is authorized to utilize the facilities, services, authorities, and funds of the Commodity Credit Corporation in discharging his functions and responsibilities under this title, including payment of costs of administration for the programs authorized under this title: *Provided*, That the Secretary shall, prior to February 1, 1957, or such earlier date as may be practicable, submit to the Congress a full program of all operations under this title which will require the making of expenditures during the fiscal year ending June 30, 1958; and, after June 30, 1957, the Commodity Credit Corporation shall not make any expenditures for carrying out the purposes of this title unless the Corporation has received funds to cover such expenditures from appropriations made to carry out the purposes of this title. There are hereby authorized to be appropriated such sums as may be necessary to carry out the purposes of this title, including such amounts as may be required to make payments to the Corporation for its actual costs incurred or to be incurred under this section. (7 U. S. C. 1808 (a).)

(b) All funds available for carrying out the purposes of this title shall be available for transfer to such agencies of the Federal or State governments as the Secretary may request to cooperate or assist in carrying out this title; and for technical assistance in formulating and carrying out the programs authorized by this title. The Secretary may make such payments in advance of determination of performance. (7 U. S. C. 1808 (b).)

FINALITY OF DETERMINATIONS

SEC. 121. The facts constituting the basis for any payment or compensation, or the amount thereof, authorized to be made under this title, when officially determined in conformity with applicable regulations prescribed by the Secretary, shall be final and conclusive and shall not be reviewable by any other officer or agency of the Government. In case any producer who is entitled to any payment or compensation dies, becomes incompetent, or disappears before receiving such payment or compensation, or is succeeded by another who renders or completes the required performance, the payment or compensation shall, without regard to any other provisions of law, be made as the Secretary may determine to be fair and reasonable in all the circumstances and so provide by regulations. (7 U. S. C. 1809.)

PROTECTION OF TENANTS AND SHARECROPPERS

SEC. 122. In the formulation and administration of programs under this title, the Secretary shall provide adequate safeguards to protect the interests of tenants and sharecroppers, including provision for sharing, on a fair and equitable basis, in payments or compensation under this title, and including such provision as may be necessary to prevent them from being forced off the farm. Applications to participate in any such program shall specify the basis on which the landlord, tenants, and sharecroppers are to share in such payments or compensation, and no contract under any such program shall be entered into unless such basis is approved by the county committee and incorporated into the contract. The standards prescribed by the Secretary for the guidance of county committees in determining whether any such basis shall be approved shall include the requirement that consideration be given to the respective contributions which would have been made by the landlord, tenants, and sharecroppers in the production of the crops which would have been produced on the acreage diverted from production under the contract and the basis on which they would have shared in such crops or the proceeds thereof. (7 U. S. C. 1810.)

PENALTY FOR GRAZING OR HARVESTING

SEC. 123. Any producer who knowingly and willfully grazes or harvests any crop from any acreage in violation of a contract entered into under section 103 or 107 shall be subject to a civil penalty equal to 50 per centum of the compensation payable for compliance with such contract for the year in which the violation occurs. Such penalty shall be in addition to any amounts required to be forfeited or

refunded under the provisions of such contract, and shall be recoverable in a civil suit brought in the name of the United States. (7 U. S. C. 1811.)

REGULATIONS

SEC. 124. The Secretary shall prescribe such regulations as he determines necessary to carry out the provisions of this title. (7 U. S. C. 1812.)

PRODUCTION ON GOVERNMENT LANDS PROHIBITED

SEC. 125. The President shall, with respect to farmlands now or hereafter owned by the Federal Government, restrict insofar as practicable the leasing of such lands for the production of price supported crops in surplus supply. Nothing contained in this section shall prevent the production of such crops on national wildlife refuges under cooperative permits where such production is necessary to maintain satisfactory wildlife populations, especially of waterfowl for beneficial use. (7 U. S. C. 1813.)

POOLING OF CONSERVATION RESERVE LAND

SEC. 126. Whenever management of family farms or optimum land use will be aided, the Secretary of Agriculture is authorized to permit farmers to pool their rights to participate jointly in the conservation reserve program on property other than their home farms. (7 U. S. C. 1814.)

COMPENSATION FOR INCORRECT INFORMATION FURNISHED UNDER 1956 PROGRAM

SEC. 127. In any case under the 1956 program in which a producer, in reliance, in good faith, on incorrect or incomplete information furnished to him by an authorized representative of the Secretary, entered into an acreage reserve or conservation reserve contract, or took action with the intention of entering into such a contract, and the producer is not entitled to receive under the provisions of the program the payment which was stipulated in the contract, or which would have been stipulated if a contract had been entered into, the Secretary is hereby authorized, whenever he deems it desirable in order to provide fair and equitable treatment to such a producer, to compensate such producer for any loss suffered by him as a result of action taken for the purpose of participating in the program. (7 U. S. C. 1801 note.) [8]

[8] Sec. 127 added by Pub. L. 85–413, 72 Stat. 118, May 16, 1958.

PART IV

PRICE SUPPORT, EXPORT AND SURPLUS REMOVAL

SUBPART A—LEGAL HISTORY AND CHARTER OF COMMODITY CREDIT CORPORATION

LEGAL HISTORY OF COMMODITY CREDIT CORPORATION

The Commodity Credit Corporation was created on October 17, 1933, under the laws of the State of Delaware pursuant to Executive Order No. 6340, dated October 16, 1933, issued by virtue of the authority vested in the President by section 2 (a) of the National Industrial Recovery Act of June 16, 1933 (48 Stat. 195). The Act of January 31, 1935 (15 U. S. C. 713), directed that the Corporation should "continue until April 1, 1937, or such earlier date as may be fixed by the President by Executive Order, to be an agency of the United States." The Corporation was continued until June 30, 1948, as an agency of the United States by successive amendments to the Act of January 31, 1935. By section 401 of the President's reorganization plan No. I (5 U. S. C. 133t, note), effective July 1, 1939, the Corporation was made a part of the United States Department of Agriculture, and its operations were placed under the supervision and control of the Secretary of Agriculture.

The Commodity Credit Corporation was originally capitalized for $3,000,000 subscribed by the Secretary of Agriculture and the Governor of the Farm Credit Administration. The funds for such subscription were derived from the appropriation authorized by section 220 of the National Industrial Recovery Act (48 Stat. 210) and made by the Fourth Deficiency Act, fiscal year 1933 (48 Stat. 274). In accordance with the Act of April 10, 1936 (15 U. S. C. 713a), the Corporation's capitalization was increased to $100,000,000, the additional $97,000,000 of the Corporation's stock being acquired by the Reconstruction Finance Corporation. By section 3 of the Act of March 8, 1938 (15 U. S. C. 713a–3), the Secretary of Agriculture, the Governor of the Farm Credit Administration, and the Reconstruction Finance Corporation were directed to transfer the ownership of the stock of the Corporation to the United States. That section also provided that all rights of the United States arising out of the ownership of such stock should be exercised by the President of the United States or by such officers or agencies as he might designate. Executive Order No. 8219, issued August 7, 1939 (4 F. R. 3565), transferred to the Secretary of Agriculture the authority to exercise on behalf of the United States all rights arising out of the ownership of the stock of the Commodity Credit Corporation.

The Delaware charter of the Commodity Credit Corporation authorized the Corporation, among other things, to engage in buying,

selling, lending, and other activities with respect to agricultural commodities, products thereof, and related facilities. These charter powers enabled the Corporation to engage in extensive operations for the purpose of increasing production, stabilizing prices, assuring adequate supplies, and facilitating the efficient distribution of agricultural commodities, foods, feeds and fibers. Many of the Corporation's operations were carried out in response to specific congressional mandates. In carrying out its operations, the Corporation was also subject to certain specific limitations placed upon it by the Congress.

Section 304 (b) of the Government Corporation Control Act (31 U. S. C. 869) required that wholly-owned Government corporations incorporated under State law be reincorporated by Act of the Congress in order to continue as agencies or instrumentalities of the United States after June 30, 1948. Accordingly, the Commodity Credit Corporation was incorporated as a Federal corporation by the Commodity Credit Corporation Act, effective as of midnight, June 30, 1948. Pursuant to the Charter Act and by appropriate action of the boards of directors of the Delaware and the Federal corporations, all the assets, funds, property and records of the Delaware corporation were transferred to the Federal corporation, and the rights and duties and liabilities of the Delaware corporation were assumed by the Federal corporation. The Charter Act also directed the dissolution of the Delaware corporation, and the Commodity Credit Corporation, a Delaware corporation, was dissolved under the laws of the State of Delaware, effective as of 9 a. m., September 15, 1948.

The Charter Act incorporated the Federal corporation for substantially the same purposes which the Delaware corporation had served, and made applicable to the Federal corporation the statutes which had been applicable to the Delaware corporation.

COMMODITY CREDIT CORPORATION CHARTER ACT [1]

AN ACT

To Provide a Federal Charter for the Commodity Credit Corporation

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Commodity Credit Corporation Charter Act." (15 U. S. C. 714 note.)

SEC. 2. CREATION AND PURPOSES.—For the purpose of stabilizing, supporting, and protecting farm income and prices, of assisting in the maintenance of balanced and adequate supplies of agricultural commodities, products thereof, foods, feeds, and fibers (hereinafter collectively referred to as "agricultural commodities"), and of facilitating the orderly distribution of agricultural commodities, there is hereby created a body corporate to be known as Commodity Credit Corporation (hereinafter referred to as the "Corporation"), which shall be an agency and instrumentality of the United States, within the Department of Agriculture, subject to the [2] general supervision and direction of the Secretary of Agriculture (hereinafter referred to as the "Secretary"). (15 U. S. C. 714.)

SEC. 3. OFFICES.—The Corporation may establish offices in such place or places as it may deem necessary or desirable in the conduct of its business. (15 U. S. C. 714a.)

SEC. 4. GENERAL POWERS.—The Corporation—

(a) Shall have succession in its corporate name. (15 U. S. C. 714b (a).)

(b) May adopt, alter, and use a corporate seal, which shall be judicially noticed. (15 U. S. C. 714b (b).)

(c) May sue and be sued, but no attachment, injunction, garnishment or other similar process, mesne or final, shall be issued against the Corporation or its property. The district courts of the United States, including the district courts of the District of Columbia and of any Territory or possession, shall have exclusive original jurisdiction, without regard to the amount in controversy,[3] of all suits brought by or against the Corporation: *Provided*, That the Corporation may intervene in any court in any suit, action, or proceeding in which it has an interest. Any suit against the Corporation shall be brought in the District of Columbia, or in the district wherein the plaintiff resides or is engaged in business. No suit by or against the Corporation shall be allowed unless (1) it shall have been brought within six years after the right accrued on which suit is brought, or (2) in the event that

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[1] Approved June 29, 1948, 62 Stat. 1070; 15 U. S. C. 714.

[2] Prior to amendment by the Act of June 7, 1949, 63 Stat. 154, the balance of the sentence read "direction and control of its Board of Directors."

[3] This phrase was added by the Act of June 7, 1949.

the person bringing such suit shall have been under legal disability or beyond the seas at the time the right accrued, the suit shall have been brought within three years after the disability shall have ceased or within six years after the right accrued on which suit is brought, whichever period is longer. The defendant in any suit by or against the Corporation may plead, by way of set-off or counterclaim, any cause of action, whether arising out of the same transaction or not, which would otherwise be barred by such limitation if the claim upon which the defendant's cause of action is based had not been barred prior to the date that the plaintiff's cause of action arose: *Provided*, That the defendant shall not be awarded a judgment on any such set-off or counterclaim for any amount in excess of the amount of the plaintiff's claim established in the suit.[4] All suits against the Corporation shall be tried by the court without a jury. Notwithstanding any other provision of this Act, the Federal Tort Claims Act (Public Law 601, Seventy-ninth Congress) shall be applicable to the Corporation. Any suit by or against the United States as the real party in interest based upon any claim by or against the Corporation shall be subject to the provisions of this subsection (c) to the same extent as though such suit were by or against the Corporation,[5] except that (1) any such suit against the United States based upon any claim of the type enumerated in title 28, section 1491, of the United States Code, may be brought in the United States Court of Claims, and (2) no such suit against the United States may be brought in a district court unless such suit might, without regard to the provisions of this Act, be brought in such court. (15 U. S. C. 714b (c).)

(d) May adopt, amend, and repeal bylaws, rules, and regulations governing the manner in which its business may be conducted and the powers vested in it may be exercised. (15 U. S. C. 714b (d).)

(e) Shall have all the rights, privileges, and immunities of the United States with respect to the right to priority of payment with respect to debts due from insolvent, deceased, or bankrupt debtors. The Corporation may assert such rights, privileges, and immunities in any suit, action, or proceeding. (15 U. S. C. 714b (e).)

(f) Shall be entitled to the use of the United States mails in the same manner and upon the same conditions as the executive departments of the Federal Government. (15 U. S. C. 714b (f).)

(g) May enter into and carry out such contracts or agreements as are necessary in the conduct of its business. State and local regulatory laws or rules shall not be applicable with respect to contracts or agreements of the Corporation or the parties thereto to the extent that such contracts or agreements provide that such laws or rules shall not be applicable, or to the extent that such laws or rules are inconsistent with such contracts or agreements. (15 U. S. C. 714b (g).)

(h) May contract for the use, in accordance with the usual customs of trade and commerce, of plants and facilities for the physical handling, storage, processing, servicing, and transportation of the agricultural commodities subject to its control.[6] The Corporation shall

[4] This and the preceding sentence were substituted by the Act of June 7, 1949, 63 Stat. 154, for the sentence reading "No suit by or against the Corporation shall be allowed unless it shall have been brought within four years after the right accrued on which suit is brought."

[5] The balance of the sentence was added by the Act of June 7, 1949.

[6] The balance of subsection (h) was substituted for previous language by the Act of June 7, 1949.

have power to acquire personal property necessary to the conduct of its business but shall not have power to acquire real property or any interest therein except that it may (a) rent or lease office space necessary for the conduct of its business and (b) acquire real property or any interest therein for the purpose of providing storage adequate to carry out effectively and efficiently any of the Corporation's programs, or of securing or discharging obligations owing to the Corporation, or of otherwise protecting the financial interest of the Corporation: *Provided*, That the authority contained in this subsection (h) shall not be utilized by the Corporation for the purpose of acquiring real property, or any interest therein, in order to provide storage facilities for any commodity unless the Corporation determines that existing privately owned storage facilities for such commodity in the area concerned are not adequate: *Provided further*, That no refrigerated cold storage facilities shall be constructed or purchased except with funds specially provided by Congress for that purpose: *And provided further*, That nothing contained in this subsection (h) shall limit the duty of the Corporation, to the maximum extent practicable consistent with the fulfillment of the Corporation's purposes and the effective and efficient conduct of its business, to utilize the usual and customary channels, facilities, and arrangements of trade and commerce in the warehousing of commodities: *And provided further*, That to encourage the storage of grain on farms, where it can be stored at the lowest cost, the Corporation shall make loans to grain growers needing storage facilities when such growers shall apply to the Corporation for financing the construction or purchase of suitable storage, and these loans shall be deducted from the proceeds of price support loans or purchase agreements made between the Corporation and the growers.[7] Notwithstanding any other provision of law, the Commodity Credit Corporation is authorized, upon terms and conditions prescribed or approved by the Secretary of Agriculture, to accept strategic and critical materials produced abroad in exchange for agricultural commodities acquired by the Corporation.[8] Insofar as practicable, in effecting such exchange of goods, normal commercial trade channels shall be utilized and priority shall be given to commodities easily storable and those which serve as prime incentive goods to stimulate production of critical and strategic materials. The determination of the quantities and qualities of such materials which are desirable for stock piling and the determination of which materials are strategic and critical shall be made in the manner prescribed by section 2 of the Strategic and Critical Materials Stock Piling Act (60 Stat. 596). Strategic and critical materials acquired by Commodity Credit Corporation in exchange for agricultural commodities shall, to the extent approved by the Munitions Board of the Department of De-

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[7] See sec. 417 of the Agricultural Act of 1949 relating to loans by the Banks for Cooperatives to cooperative associations to finance construction of structures for storage of agricultural commodities if Commodity Credit Corporation has agreed to lease or guarantee utilization of 75 percent of the storage space.

[8] See also sec. 303 of the Agricultural Trade Development and Assistance Act of 1954, sec. 103 of the Agricultural Act of 1954, sec. 206 of the Agricultural Act of 1956, and sec. 416 of the Agricultural Act of 1949 relating to barters and exchanges of agricultural commodities owned by Commodity Credit Corporation for strategic and other materials. Strategic materials may also be acquired under sec. 104 (b) (by purchase, using foreign currencies accruing under Title I) and sec. 104 (g) (in payment of loans to promote multilateral trade and economic development) of the Agricultural Trade Development and Assistance Act of 1954.

fense,[9] be transferred to the stock pile provided for by the Strategic and Critical Materials Stock Piling Act; and when transferred to the stock pile the Commodity Credit Corporation shall be reimbursed for the strategic and critical materials so transferred to the stock pile from the funds made available for the purpose of the Strategic and Critical Materials Stock Piling Act, in an amount equal to the fair market value, as determined by the Secretary of the Treasury,[10] of the material transferred to the stock pile. Nothing contained herein shall limit the authority of the Commodity Credit Corporation to acquire, hold, or dispose of such quantity of strategic and critical materials as it deems advisable in carrying out its functions and protecting its assets. (15 U. S. C. 714b h))

(i) May borrow money subject to any provision of law applicable to the Corporation: *Provided*, That the total of all money borrowed by the Corporation, other than trust deposits and advances received on sales, shall not at any time exceed in the aggregate $14,500,000,000.[11] The Corporation shall at all times reserve a sufficient amount of its authorized borrowing power which, together with other funds available to the Corporation, will enable it to purchase, in accordance with its contracts with lending agencies, notes, or other obligations evidencing loans made by such agencies under the Corporation's programs. (15 U. S. C. 714b (i).)

(j) Shall determine the character of and the necessity for its obligations and expenditures and the manner in which they shall be incurred, allowed, and paid. (15 U. S. C. 714b(j).)

(k) Shall have authority to make final and conclusive settlement and adjustment of any claims by or against the Corporation or the accounts of its fiscal officers. (15 U. S. C. 714b(k).)

(l) May make such loans and advances of its funds as are necessary in the conduct of its business. (15 U. S. C. 714b (l).)

(m) Shall have such powers as may be necessary or appropriate for the exercise of the powers specifically vested in the Corporation, and all such incidental powers as are customary in corporations generally; but any research financed by the Corporation shall relate to the conservation or disposal of commodities owned or controlled by the Corporation and shall be conducted in collaboration with research agencies of the Department of Agriculture. (15 U. S. C. 714b (m).)

Sec. 5. Specific Powers.—In the fulfillment of its purposes and in carrying out its annual budget programs submitted to and approved by the Congress pursuant to the Government Corporation Control Act (31 U. S. C., 1940 edition, Supp. V, 841), the Corporation is authorized to use its general powers only to—

(a) Support the prices of agricultural commodities through loans, purchases, payments, and other operations.

(b) Make available materials and facilities required in connection with the production and marketing of agricultural commodities.

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[9] "Department of Defense" substituted for "National Military Establishment" by the Act of August 10, 1949, 63 Stat. 578, 591.

[10] This function was transferred to the Administrator of General Services by sec. 102 of the Act of June 30, 1949, 63 Stat. 380; 5 U. S. C. 630a.

[11] Borrowing power increased from $4,750,000,000 to $6,750,000,000 by the Act of June 28, 1950, 64 Stat. 261; to $8,500,000,000 by the Act of March 20, 1954, 68 Stat. 30; to $10,000,000,000 by the Act of August 31, 1954, 68 Stat. 1047; to $12,000,000,000 by the Act of August 11, 1955, 69 Stat. 634; and to $14,500,000,000 by the Act of August 1, 1956, 70 Stat. 783.

(c) Procure agricultural commodities for sale to other Government agencies, foreign governments, and domestic, foreign, or international relief or rehabilitation agencies, and to meet domestic requirements.

(d) Remove and dispose of or aid in the removal or disposition of surplus agricultural commodities.

(e) Increase the domestic consumption of agricultural commodities by expanding or aiding in the expansion of domestic markets or by developing or aiding in the development of new and additional markets, marketing facilities, and uses for such commodities.

(f) Export or cause to be exported, or aid in the development of foreign markets for, agricultural commodities.

(g) Carry out such other operations as the Congress may specifically authorize or provide for.

In the Corporations purchasing and selling operations with respect to agricultural commodities (except sales to other Government agencies), and in the warehousing, transporting, processing, or handling of agricultural commodities, the Corporation shall, to the maximum extent practicable consistent with the fulfillment of the Corporation's purposes and the effective and efficient conduct of its business, utilize the usual and customary channels, facilities, and arrangements of trade and commerce. (15 U. S. C. 714c)

SEC. 6. EXISTING STATUTES APPLICABLE TO THE CORPORATION.—The Federal statutes applicable to Commodity Credit Corporation, a Delaware corporation, shall be applicable to the Corporation. Commodity Credit Corporation, a Delaware corporation, shall cease to be an agency of the United States as provided in section 7 (a) of the Act of January 31, 1935, as amended (15 U. S. C., 1940 edition, Supp. V, 713 (a)). (15 U. S. C. 714d)

SEC. 7. CAPITAL STOCK.—The Corporation shall have a capital stock of $100,000,000 which shall be subscribed by the United States. Such subscription shall be deemed to be fully paid by the transfer of assets to the Corporation pursuant to section 16 of this Act. The Corporation shall pay interest to the United States Treasury on the amount of its capital stock, and on the amount of the obligations of the Corporation purchased by the Secretary of the Treasury pursuant to the Act of March 8, 1938 (U. S. C., title 15, sec. 713a–4), as amended, at such rates as may be determined by the Secretary of the Treasury to be appropriate in view of the terms for which such amounts are made available to the Corporation. (15 U. S. C. 714e)

SEC. 8. FUNDS.—The Corporation is authorized to use in the conduct of its business all its funds and other assets, including capital and net earnings therefrom, and all funds and other assets which have been or may hereafter be transferred or allocated to, borrowed by, or otherwise acquired by it. (15 U. S. C. 714f)

SEC. 9. DIRECTORS, ADVISORY BOARD: (a) The management of the Corporation shall be vested in a board of directors (hereinafter referred to as the "Board"), subject to the general supervision and direction of the Secretary. The Secretary shall be an ex officio director and shall serve as Chairman of the Board. The Board shall consist of six members (in addition to the Secretary), who shall be appointed by the President by and with the advice and consent of the Senate. In addition to their duties as members of the Board, such

appointed members shall perform such other duties as may be prescribed by the Secretary. Each appointed member of the Board shall receive compensation at such rate not in excess of the maximum then payable under the [CLASSIFICATION ACT OF 1949],[12] as may be fixed by the Secretary, except that any such member who holds another office or position under the Federal Government the compensation for which exceeds such rate may elect to receive compensation at the rate provided for such other office or position in lieu of the compensation provided by this section. A majority of the directors shall constitute a quorum of the Board and action shall be taken only by a majority vote of those present. (15 U. S. C. 714g (a).)

(b) In addition to the Board of Directors there shall be an advisory board reflecting broad agricultural and business experience in its membership and consisting of five members who shall be appointed by the President, and who shall serve at the pleasure of the President. Not more than three of such members shall belong to the same political party. The advisory board shall meet at the call of the Secretary, who shall require it to meet not less often than once each ninety days; shall survey the general policies of the Corporation, including its policies in connection with the purchase, storage, and sale of commodities, and the operation of lending and price-support programs; and shall advise the Secretary with respect thereto. Members of the advisory board shall receive for their services as members compensation of not to exceed $50 per diem when actually engaged in the performance of their duties as such, together with their necessary traveling expenses while going to and coming from meetings. (15 U. S. C. 714g (b).)[13]

SEC. 10. PERSONNEL OF CORPORATION.—The Secretary shall appoint such officers and employees as may be necessary for the conduct of the business of the Corporation, define their authority and duties, delegate to them such of the powers vested in the Corporation as he may determine, require that such of them as he may designate be bonded and fix the penalties therefor. The Corporation may pay the premium of any bond or bonds. With the exception of experts, appointments shall be made pursuant to the civil service laws and the [Classification Act of 1949][12]. (15 U. S. C. 714h)[14]

SEC. 11. COOPERATION WITH OTHER GOVERNMENT AGENCIES.—The Corporation may, with the consent of the agency concerned, accept and utilize, on a compensated or uncompensated basis, the officers, employees, services, facilities, and information of any agency of the Federal Government, including any bureau, office, administration, or other agency of the Department of Agriculture, and of any State, the District of Columbia, any Territory or possession, or any political subdivision thereof. The Corporation may allot to any bureau, office, administration, or other agency of the Department of Agriculture or transfer to such other agencies as it may request to assist it in the conduct of its business any of the funds available to it for administrative expenses. The personnel and facilities of the Cor-

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[12] As originally enacted, secs. 9 and 10 referred to the Classification Act of 1923, as amended, which was repealed and superseded by the Classification Act of 1949 (approved October 28, 1949, 63 Stat. 954; 5 U. S. C. 1071).

[13] The provisions of this section were substituted for the previous provisions by the Act of June 7, 1949, 63 Stat. 154, 155.

[14] The provisions of this section were substituted for the previous provisions by the Act of June 7, 1949, 63 Stat. 154, 156.

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poration may, with the consent of the Corporation, be utilized on a reimbursable basis by any agency of the Federal Government, including any bureau, office, administration, or other agency of the Department of Agriculture, in the performance of any part or all of the functions of such agency. (15 U. S. C. 714i)

SEC. 12. UTILIZATION OF ASSOCIATIONS AND TRADE FACILITIES.—The Corporation may, in the conduct of its business, utilize on a contract or fee basis, committees or associations of producers, producer-owned and producer-controlled cooperative associations, and trade facilities. (15 U. S. C. 714j)

SEC. 13. RECORDS; ANNUAL REPORT.—The Corporation shall at all times maintain complete and accurate books of account and shall file annually with the Secretary of Agriculture a complete report as to the business of the Corporation, a copy of which shall be forwarded by the Secretary of Agriculture to the President for transmission to the Congress. (15 U. S. C. 714k)

SEC. 14. INTEREST OF MEMBERS OF THE CONGRESS.—The provisions of section 1 of the Act of February 27, 1877, as amended (41 U. S. C., 1940 edition, 22), shall apply to all contracts or agreements of the Corporation, except contracts or agreements of a kind which the Corporation may enter into with farmers participating in a program of the Corporation. (15 U. S. C. 714*l*)

SEC. 15. CRIMES AND OFFENSES.—

FALSE STATEMENTS; OVERVALUATION OF SECURITIES

(a) Whoever makes any statement knowing it to be false, or whoever willfully overvalues any security, for the purpose of influencing in any way the action of the Corporation, or for the purpose of obtaining for himself or another, money, property, or anything of value, under this Act, or under any other Act applicable to the Corporation, shall, upon conviction thereof, be punished by a fine of not more than $10,000 or by imprisonment by not more than five years, or both. (15 U. S. C. 714m (a).)

EMBEZZLEMENT, AND SO FORTH; FALSE ENTRIES; FRAUDULENT ISSUE OF OBLIGATIONS OF CORPORATION

(b) Whoever, being connected in any capacity with the Corporation or any of its programs, (i) embezzles, abstracts, purloins, or willfully misapplies any money, funds, securities, or other things of value, whether belonging to the Corporation or pledged, or otherwise entrusted to it; or (ii) with intent to defraud the Corporation, or any other body, politic or corporate, or any individual, or to deceive any officer, auditor, or examiner of the Corporation, makes any false entry in any book, report, or statement of, or to, the Corporation, or draws any order, or issues, puts forth or assigns any note or other obligation or draft, mortgage, judgment, or decree thereof; or (iii) with intent to defraud the Corporation, participates or shares in, or receives directly or indirectly any money, profit, property, or benefits through any transaction, loan, commission, contract, or any other act of the Corporation, shall, upon conviction thereof, be punished by a fine of not more than $10,000 or by imprisonment for not more than five years, or both. (15 U. S. C. 714m (b).)

LARCENY; CONVERSION OF PROPERTY

(c) Whoever shall willfully steal, conceal, remove, dispose of, or convert to his own use or to that of another any property owned or held by, or mortgaged or pledged to, the Corporation, or any property mortgaged or pledged as security for any promissory note, or other evidence of indebtedness, which the Corporation has guaranteed or is obligated to purchase upon tender, shall, upon conviction thereof, if such property be of an amount or value in excess of $500, be punished by a fine of not more than $10,000 or by imprisonment for not more than five years, or both, and, if such property be of an amount or value of $500 or less, be punished by a fine of not more than $1,000 or by imprisonment for not more than one year, or both. (15 U. S. C. 714m (c).) [15]

CONSPIRACY TO COMMIT OFFENSE

(d) Whoever conspires with another to accomplish any of the acts made unlawful by the preceding provisions of this section shall, upon conviction thereof, be subject to the same fine or imprisonment, or both, as is applicable in the case of conviction for doing such unlawful acts. (15 U. S. C. 714m (d).)

GENERAL STATUTES APPLICABLE

(e) All the general penal statutes relating to crimes and offenses against the United States shall apply with respect to the Corporation, its property, money, contracts and agreements, employees, and operations: *Provided*, That such general penal statutes shall not apply to the extent that they relate to crimes and offenses punishable under subsections (a), (b), (c), and (d) of this section: *Provided further*, That sections 114 and 115 of the Act of March 4, 1909, as amended (18 U. S. C., 1940 edition, 204, 205), shall not apply to contracts or agreements of a kind which the Corporation may enter into with farmers participating in a program of the Corporation. (15 U. S. C. 714m (e).)

USE OF WORDS "COMMODITY CREDIT CORPORATION"

(f) No individual, association, partnership, or corporation shall use the words "Commodity Credit Corporation" or any combination of the same, as the name or a part thereof under which he or it shall do or purport to do business. Every individual, partnership, association, or corporation violating this prohibition shall be guilty of a misdemeanor and shall be punished by a fine of not more than $1,000 or by imprisonment for not more than one year, or both. (15 U. S. C. 714m (f).) [16]

SEC. 16. TRANSFER OF ASSETS OF COMMODITY CREDIT CORPORATION, A DELAWARE CORPORATION.—The assets, funds, property, and records of Commodity Credit Corporation, a Delaware corporation, are hereby transferred to the Corporation. The rights, privileges, and pow-

[15] Substituted for original provisions of this subsection by the Act of August 1, 1956, 70 Stat. 783.

[16] Subsec. (f) added by the Act of June 7, 1949, 63 Stat. 154, 157.

ers, and the duties and liabilities of Commodity Credit Corporation, a Delaware corporation, in respect to any contract, agreement, loan, account, or other obligation shall become the rights, privileges, and powers, and the duties and liabilities, respectively, of the Corporation. The enforceable claims of or against Commodity Credit Corporation, a Delaware corporation, shall become the claims of or against, and may be enforced by or against, the Corporation: *Provided*, That nothing in this Act shall limit or extend any period of limitation otherwise applicable to such claims against the Corporation. (15 U. S. C. 714n)

SEC. 17. DISSOLUTION OF DELAWARE CORPORATION.—The Secretary of Agriculture, representing the United States as the sole owner of the capital stock of Commodity Credit Corporation, a Delaware corporation, is hereby authorized and directed to institute or cause to be instituted such proceedings as are required for the dissolution of said Corporation under the laws of the State of Delaware.[17] The costs of such dissolution of said Corporation shall be borne by the Corporation. (15 U. S. C. 714*o*)

SEC. 18. EFFECTIVE DATE.—This Act shall take effect as of midnight June 30, 1948. (15 U. S. C. 714 note)

SEC. 19. RELEASE OF INNOCENT PURCHASERS OF CONVERTED GOODS.—A buyer in the ordinary course of business of fungible goods heretofore or hereafter sold and physically delivered by a warehouseman or other dealer who was regularly engaged in the business of buying and selling such goods shall take or be deemed to have taken such goods free of any claim, existing or hereafter arising, by Commodity Credit Corporation, based on the want of authority in the seller to sell such goods, provided the buyer purchased such goods for value in good faith and did not know or have reason to know of any defect in the seller's authority to sell such goods. To be entitled to relief under this section a buyer must assert as an affirmative defense and establish by a preponderance of the evidence the facts necessary to entitle him to such relief. (15 U. S. C. 714p) [18]

[17] The Delaware Corporation was dissolved under the laws of the State of Delaware, effective 9 a. m., September 15, 1948.
[18] Sec. 19 added by the Act of May 23, 1955, 69 Stat. 65.

SUBPART B—PRICE SUPPORT

EXPLANATORY NOTE

Price support directly to producers was first made available in 1933 by loans to cotton and corn producers by the Commodity Credit Corporation. In the Agricultural Adjustment Act of 1938 (Section 302), the Congress enacted the first comprehensive legislation dealing with price support. Additional legislation thereafter included:

The Act of April 3, 1941 (55 Stat. 90; 7 U. S. C. 1359) (providing for loans on peanuts).

The Act of May 26, 1941, as amended (55 Stat. 203, 55 Stat. 860; 7 U. S. C. 1330, 1340) (providing for loans on basic commodities through the 1946 crop).

Section 4 of the Act of July 1, 1941, as amended (55 Stat. 498, 56 Stat. 768; 15 U. S. C. 713a–8) (the so-called "Steagall amendment", which provided that if the Secretary of Agriculture issued an announcement requesting the expansion of production of a non-basic agricultural commodity, he should provide price support on such commodity for two years after World War II).

Section 8 of the Stabilization Act of 1942, as amended (56 Stat. 767, 58 Stat. 643, 58 Stat. 784; 50 U. S. C. App. 968) (providing for loans on basic commodities for two years after World War II).

The Act of July 28, 1945 (59 Stat. 506; 7 U. S. C. 1312 note) (set forth on p. 122 of this compilation, providing for loans on tobacco).

The Act of August 5, 1947, as amended (61 Stat. 769, 62 Stat. 1248; 15 U. S. C. 713a–8 note) (providing for price support on wool).

Much of this legislation expired with the termination of the wartime emergency and was succeeded by the Agricultural Act of 1948 (62 Stat. 1247). The Agricultural Act of 1949 (p. 120) (7 U. S. C. 1421) superseded or repealed prior legislation, effective for the 1950 and subsequent crop years. The Agricultural Act of 1954 (p. 138), the Agricultural Act of 1956 (p. 145), and the Agricultural Act of 1958 (Pub. L. 85–835, 72 Stat. 988) made significant changes in the 1949 Act.

Throughout the periods discussed, the Commodity Credit Corporation has been the chief instrumentality in making price support available to producers. Export and surplus removal programs operated under Section 32 of Public Law 320, 74th Congress (p. 174), are also utilized as a means of price support.

AGRICULTURAL ACT OF 1949,[1]

AN ACT

To stabilize prices of agricultural commodities.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Agricultural Act of 1949." (7 U. S. C. 1421 note)

TITLE I—BASIC AGRICULTURAL COMMODITIES

SEC. 101. The Secretary of Agriculture (hereinafter called the "Secretary") is authorized and directed to make available through loans, purchases, or other operations, price support to cooperators for any crop of any basic agricultural commodity, if producers have not disapproved marketing quotas for such crop, at a level not in excess of 90 per centum of the parity price of the commodity nor less than the level provided in subsections (a), (b), and (c) as follows:

(a) For tobacco (except as otherwise provided herein), corn, and wheat,[2] if the supply percentage as of the beginning of the marketing year is:

	The level of support shall be not less than the following percentage of the parity price:
Not more than 102	90
More than 102 but not more than 104	89
More than 104 but not more than 106	88
More than 106 but not more than 108	87
More than 108 but not more than 110	86
More than 110 but not more than 112	85
More than 112 but not more than 114	84
More than 114 but not more than 116	83
More than 116 but not more than 118	82
More than 118 but not more than 120	81
More than 120 but not more than 122	80
More than 122 but not more than 124	79
More than 124 but not more than 126	78
More than 126 but not more than 128	77
More than 128 but not more than 130	76
More than 130	75

For rice of the 1959 and 1960 crops, the level of support shall be not less than 75 per centum of the parity price. For rice of the 1961 crop the level of support shall be not less than 70 per centum of the parity price. For the 1962 and subsequent crops of rice the level of support shall be not less than 65 per centum of the parity price.[3] (7 U. S. C. 1441 (a))

[1] Approved October 31, 1949, 63 Stat. 1051.

[2] This subsection was amended by sec. 302 of the Agricultural Act of 1958 (Pub. L. 85–835, 72 Stat. 988), effective beginning with the 1959 crop, by striking out "wheat, and rice" and inserting "and wheat". For corn of the 1959 and subsequent crop years, see sec 105 (a).

[3] This paragraph was added by sec. 302 of the Agricultural Act of 1958, effective beginning with the 1959 crop.

(b) For cotton and peanuts, if the supply percentage as of the beginning of the marketing year is:

	The level of support shall be not less than the following percentage of the parity price:
Not more than 108	90
More than 108 but not more than 110	89
More than 110 but not more than 112	88
More than 112 but not more than 114	87
More than 114 but not more than 116	86
More than 116 but not more than 118	85
More than 118 but not more than 120	84
More than 120 but not more than 122	83
More than 122 but not more than 124	82
More than 124 but not more than 125	81
More than 125 but not more than 126	80
More than 126 but not more than 127	79
More than 127 but not more than 128	78
More than 128 but not more than 129	77
More than 129 but not more than 130	76
More than 130	75

(7 U. S. C. 1441 (b).)

(c) For tobacco, if marketing quotas are in effect, the level of support shall be 90 percentum of the parity price. (7 U. S. C. 1441 (c))

(d) Notwithstanding the foregoing provisions of this section—

(1) if producers have not disapproved marketing quotas for such crop, the level of support to cooperators shall be 90 per centum of the parity price for the 1950 crop of any basic agricultural commodity for which marketing quotas or acreage allotments are in effect;

(2) if producers have not disapproved marketing quotas for such crop, the level of support to cooperators shall be not less than 80 per centum of the parity price for the 1951 crop of any basic agricultural commodity for which marketing quotas or acreage allotments are in effect;

(3) the level of price support to cooperators for any crop of a basic agricultural commodity, except tobacco, for which marketing quotas have been disapproved by producers shall be 50 per centum of the parity price of such commodity; and no price support shall be made available for any crop of tobacco for which marketing quotas have been disapproved by producers;

(4) [4]

(5) price support may be made available to noncooperators at such levels, not in excess of the level of price support to cooperators, as the Secretary determines will facilitate the effective operation of the program.

(6) Except as provided in subsection (c) and section 402, the level of support to cooperators shall be not more than 90 per centum and not less than 82½ per centum of the parity price for the 1955 crop of any basic agricultural commodity with respect to which producers have not disapproved marketing quotas;

[4] Subsec. (4) was repealed, effective with the 1959 crop, by sec. 201 of the Agricultural Act of 1958.

within such limits, the minimum level of support shall be fixed as provided in subsections (a) and (b) of this section.[5]

(7) Where a State is designated under section 335 (e) of the Agricultural Adjustment Act of 1938, as amended, as outside the commercial wheat-producing area for any crop of wheat, the level of price support for wheat to cooperators in such State for such crop of wheat shall be 75 per centum of the level of price support to cooperators in the commercial wheat-producing area. (7 U. S. C. 1441 (d).) [6]

(e) Notwithstanding any of the provisions of this Act, section 2 of the Act of July 28, 1945 (59 Stat. 506) shall continue in effect. (7 U. S. C. 1441 (e).)

[Loans on Tobacco—Act of July 28, 1945—Sec. 2. Notwithstanding any other provision of law, the Commodity Credit Corporation is authorized and directed, beginning with the 1945 crop, to make available upon any crop of fire-cured, dark air-cured and Virginia sun-cured tobacco, if producers have not disapproved marketing quotas for such tobacco for the marketing year beginning with the calendar year in which such crop is harvested, loans or other price support at, in the case of fire-cured tobacco, 75 per centum of the loan rate for burley tobacco for the corresponding crop and, in the case of dark air-cured and Virginia sun-cured tobacco, at 66⅔ per centum of such burley tobacco loan rate: *Provided*, That, beginning with the 1958 crop, the levels of support for such kinds of tobacco shall not exceed the higher of (a) the level applicable to the 1957 crop or (b) 90 per centum of the parity price.[7] (59 Stat. 506; 7 U. S. C. 1312 note)]

(f) The provisions of this Act relating to price support for cotton shall apply severally to (1) American upland cotton and (2) extra long staple cotton described in subsection (a) and ginned as required by subsection (e) of section 347 of the Agricultural Adjustment Act of 1938, as amended, except that, notwithstanding any of the foregoing provisions of section 101 of this Act, the level of support to cooperators for the 1957 and each subsequent crop of extra long staple cotton, if producers have not disapproved marketing quotas therefor, shall not exceed the same per centum of the parity price as for the 1956 crop and shall be determined after consideration of the factors specified in section 401 (b) and the price levels for similar qualities of cotton produced outside the United States: *Provided*, That such level of price support shall be not less than 60 per centum of the parity price. Disapproval by producers of the quota proclaimed under such section 347 shall place into effect the provisions of section 101 (d) (3) of this Act with respect to the extra long staple cotton described in subsection (a) of such section 347. Nothing contained herein shall affect the authority of the Secretary under

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[5] Prior to amendment by subsec. 201 (a) of the Agricultural Act of 1954, par. (6) (added by the Act of July 17, 1952, 66 Stat. 758, 759) read: "The level of support of cooperators shall be 90 per centum of the parity price for the 1953 and 1954 crops of any basic agricultural commodity with respect to which producers have not disapproved marketing quotas."

[6] Par. (7) added by subsec. 201 (b) of the Agricultural Act of 1954.

[7] Proviso added by the Act of July 10, 1957, 71 Stat. 284.

section 402 to make support available for extra long staple cotton in accordance with such section 402. (7 U. S. C. 1441 (f).) [8]

PROGRAM FOR 1959 AND 1960 (COTTON)

SEC. 102. Notwithstanding any other provisions of law—

(a) for each of the 1959 and 1960 crops of upland cotton the Secretary of Agriculture is authorized and directed to offer the operator of each farm for which an allotment is established under section 344 of the Agricultural Adjustment Act of 1938, as amended, a choice of (A) the farm acreage allotment determined pursuant to section 344 of the Agricultural Adjustment Act of 1938, as amended, and price support determined pursuant to section 101 of this Act (the amount of cotton estimated to be produced on the additional acres allotted to producers selecting choice (B) for such year being taken into account in computing such support), except that for the 1959 crop the level of support shall be not less than 80 per centum of parity, or (B) the farm acreage allotment determined pursuant to section 344 of the Agricultural Adjustment Act of 1938, as amended, increased by not to exceed 40 per centum (such increased acreage allotment to be the acreage allotment for the farm for all purposes) and price support at a level which is 15 per centum of parity below the level of support established for producers who elect choice (A). Any person operating more than one farm, in order to be eligible for choice (B), must elect choice (B) for all farms for which he is operator. Not later than January 31, the Secretary shall determine and announce on the basis of his estimate of the supply percentage and the parity price as of the following August 1, the price support level for producers who elect choice (A) and choice (B) respectively, and such price support levels shall be final. As soon as practicable after such announcement, the Secretary shall cause the operator (as shown on the records of the county committee) of each farm for which an allotment is established under section 344 of the Agricultural Adjustment Act of 1938, as amended, to be notified of the alternative levels of price support and the alternative acreage allotments available for his farm. The operator of each farm shall, within the time prescribed by the Secretary, notify the county committee in writing whether he desires the increased acreage allotment and the level of price support prescribed in choice (B) to be effective for the farm. If the operator fails to so notify the county committee within the time prescribed, he shall be deemed to have chosen the acreage allotment and the price support level prescribed in choice (A). The choice elected by the operator shall apply to all the producers on the farm. Notwithstanding the foregoing provisions of this subsection, the Secretary may permit the operator of a farm for which choice (B) is in effect to change to choice (A) where conditions beyond the control of the farm operator, such as excessive rain, flood, or drought, pre-

[8] Subsec. (f) added by the Act of July 17, 1952, 66 Stat. 758, 759. The first sentence has been amended by sec. 202 of the Agricultural Act of 1954, the Act of April 25, 1957, 71 Stat. 27, and the Act of July 2, 1958, Pub. L. 85-497, 72 Stat. 296.

vented the planting of acreage to cotton or having cotton acreage available for harvest on the farm in accordance with the plans of such operator in selecting choice (B). The additional acreage required to be allotted to farms under this section shall be in addition to the county, State, and national acreage allotments and the production from such acreage shall be in addition to the national marketing quota. The additional acreage authorized by this section shall not be taken into account in establishing future State, county, and farm acreage allotments. Notwithstanding any other provision of law, no farm participating in any cotton acreage reserve program established for 1959 under the Soil Bank Act shall receive an increased acreage allotment under the provisions of this section for 1959. Notwithstanding the provisions of section 344 (m) (2) any farm cotton acreage allotment increased as the result of the selection of choice (B) may not be released and reapportioned to any other farm. Price support shall be made available under this paragraph only to cooperators and only if producers have not disapproved marketing quotas for the crop. (7 U. S. C. 1443 (a).)

(b) for each of the 1959 and 1960 crops of upland cotton, price support shall be made available to producers who elect choice (A) through a purchase program. Price support shall be made available to producers who elect choice (B) through loans, purchases, or other operations. (7 U. S. C. 1443 (b).)

(c) the Commodity Credit Corporation is directed, during the period beginning August 1, 1959, and ending July 31, 1961, to offer any upland cotton owned by it for sale for unrestricted use at not less than 10 per centum above the current level of price support prescribed in choice (B). (7 U. S. C. 1443 (c).) [9]

PRICE SUPPORT FOR 1961 AND SUBSEQUENT YEARS (COTTON)

Sec. 103. Notwithstanding the provisions of section 101 of this Act, price support to cooperators for each crop of upland cotton, beginning with the 1961 crop, for which producers have not disapproved marketing quotas shall be at such level not more than 90 per centum of the parity price therefor nor less than the minimum level prescribed below as the Secretary determines appropriate after consideration of the factors specified in section 401 (b) of this Act. For the 1961 crop the minimum level shall be 70 per centum of the parity price therefor, and for each subsequent crop the minimum level shall be 65 per centum of the parity price therefor. Price support in the case of noncooperators and in case marketing quotas are disapproved shall be as provided in section 101 (d) (3) and (5). (7 U. S. C. 1444) [10]

REFERENDUM (CORN)

Sec. 104.[11]

[9] Sec. 102 added by sec. 101 of the Agricultural Act of 1958, Pub. L. 85–835, 72 Stat. 988.

[10] Sec. 103 added by sec. 102 of the Agricultural Act of 1958.

[11] This section (7 U. S. C. 1441 note), which was added by sec. 201 of the Agricultural Act of 1958, provided for a referendum of corn producers to determine if they favored a price support program as provided in sec. 105 in lieu of price support as provided in sec. 101 and acreage allotments. A majority of producers voted for the sec. 105 program, and, beginning with the 1959 crop, price support will be made available thereunder and acreage allotments and a commercial corn producing area will not be established. This section also repealed subsec. 101 (h) (4), effective with the 1959 crop.

PRICE SUPPORT (CORN AND FEED GRAINS)

SEC. 105. (a) Notwithstanding the provisions of section 101 of this Act, beginning with the 1959 crop, price support shall be made available to producers for each crop of corn at 90 per centum of the average price received by farmers during the three calendar years immediately preceding the calendar year in which the marketing year for such crop begins, adjusted to offset the effect on such price of any abnormal quantities of low-grade corn marketed during any of such year: *Provided*, That the level of price support for any crop of corn shall not be less than 65 per centum of the parity price therefor.

(b) Beginning with the 1959 crop, price support shall be made available to producers for each crop of oats, rye, barley, and grain sorghums at such level of the parity price therefor as the Secretary of Agriculture determines is fair and reasonable in relation to the level at which price support is made available for corn, taking into consideration the feeding value of such commodity in relation to corn, and the other factors set forth in section 401 (b) hereof. (7 U. S. C. 1441 note) [12]

TITLE II—DESIGNATED NONBASIC AGRICULTURAL COMMODITIES

SEC. 201. The Secretary is authorized and directed to make available (without regard to the provisions of title III) price support to producers for [13] tung nuts, honey,[14] milk, butterfat, and the products of milk and butterfat as follows:

(a) [13]

(b) The price of tung nuts and honey,[14] respectively, shall be supported through loans, purchases, or other operations at a level not in excess of 90 per centum nor less than 60 per centum of the parity price therefor: *Provided*, That in any crop year in which the Secretary determines that the domestic production of tung oil will be less than the anticipated domestic demand for such oil, the price of tung nuts shall be supported at not less than 65 per centum of the parity price therefor; [15]

(c) The price of whole milk, butterfat, and the products of such commodities, respectively, shall be supported at such level not in excess of 90 per centum nor less than 75 per centum of the parity price therefor as the Secretary determines necessary in order to assure an adequate supply. Such price support shall be provided through loans on, or purchases of, milk and the products of milk and butterfat, and for the period ending March 31, 1956, surplus stocks of dairy products owned by the Commodity Credit Corporation may be disposed of by any methods determined necessary by the Secretary. For the period beginning September 1, 1954, and ending June 30, 1955, not to exceed $50,000,000, and for the fiscal year ending

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[12] Added by sec. 201 of the Agricultural Act of 1958.

[13] Sec. 709 of the Agricultural Act of 1954 (p. 144) deleted the reference to wool in the first sentence and repealed subsec. (a), which provided for price support on wool, effective April 1, 1955. Beginning on that date, price support on wool has been made available under Title VII—National Wool Act of 1954 of the Agricultural Act of 1954 (p. 141).

[14] Sec. 203 of the Agricultural Act of 1954 (p. 138) deleted references to potatoes in the first sentence and in subsection (b) and repealed section 5 of the Act of March 31, 1950, which prohibited price support on Irish potatoes unless marketing quotas were in effect.

[15] Proviso added by sec. 503 of the Agricultural Act of 1958.

June 30, 1956, not to exceed $60,000,000, and for each of the two fiscal years in the period beginning July 1, 1956, and ending June 30, 1958, not to exceed $75,000,000, of the funds of the Commodity Credit Corporation shall be used to increase the consumption of fluid milk by children in (1) nonprofit schools of high-school grade and under; and in (2) nonprofit nursery schools, child-care centers, settlement houses, summer camps, and similar nonprofit institutions devoted to the care and training of children. (7 U. S. C. 1446) [16]

[Public Law 85–478

July 1, 1958

AN ACT

To continue the special milk program for children in the interest of improved nutrition by fostering the consumption of fluid milk in the schools.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for each of the three fiscal years in the period beginning July 1, 1958, and ending June 30, 1961, not to exceed $75,000,000 of the funds of the Commodity Credit Corporation shall be used to increase the consumption of fluid milk by children (1) in nonprofit schools of high-school grade and under; and (2) in nonprofit nursery schools, child-care centers, settlement houses, summer camps, and similar nonprofit institutions devoted to the care and training of children. Amounts expended hereunder and under the authority contained in the last sentence of section 201 (c) of the Agricultural Act of 1949, as amended, shall not be considered as amounts expended for the purpose of carrying out the price-support program. (72 Stat. 276; 7 U. S. C. 1446 note)]

SEC. 202. As a means of increasing the utilization of dairy products, (including for purposes of this section, milk) upon the certification by the Administrator of Veterans' Affairs or by the Secretary of the Army, acting for the military departments under the Department of Defense's Single Service Purchase Assignment for Subsistence, or their duly authorized representatives that the usual quantities of dairy products have been purchased in the normal channels of trade—

(a) The Commodity Credit Corporation until December 31, 1961, shall make available to the Administrator of Veterans' Affairs at warehouses where dairy products are stored, such dairy products acquired under price-support programs as the Administrator certifies that he requires in order to provide butter and cheese and other dairy products as a part of the ration in hospitals under his jurisdiction. The Administrator shall report monthly to the Committees on Agriculture of the Senate and House of Representatives and the Secretary of Agriculture the amount of dairy products used under this subsection.

(b) The Commodity Credit Corporation until December 31, 1961, shall make available to the Secretary of the Army, at warehouses

[16] The provisions of subsec. (c) were substituted for the previous provisions by sec. 204 (b) of the Agricultural Act of 1954. The last sentence was substituted by the Act of July 20, 1956, 70 Stat. 596, for the previous provision.

where dairy products are stored, such dairy products acquired under price-support programs as the Secretary of the Army or his duly authorized representative certifies can be utilized in order to provide additional butter and cheese and other dairy products as a part of the ration (1) of the Army, Navy, Air Force, or Coast Guard, (2) in hospitals under the jurisdiction of the Department of Defense, and (3) of cadets and midshipmen at, and other personnel assigned to, the United States Merchant Marine Academy. The Secretary of the Army shall report every six months to the Committees on Agriculture of the Senate and the House of Representatives and the Secretary of Agriculture the amount of dairy products used under this subsection.

(c) Dairy products made available under this section shall be made available without charge, except that the Secretary of the Army or the Administrator of Veterans' Affairs shall pay the Commodity Credit Corporation the costs of packaging incurred in making such products so available.

(d) The obligation of the Commodity Credit Corporation to make dairy products available pursuant to the above shall be limited to dairy products acquired by the Corporation through price-support operations and not disposed of under provisions (1) and (2) of section 416 of this Act, as amended. (7 U. S. C. 1446a) [17]

[MILK AND DAIRY PRODUCTS—Agricultural Act of 1954—Sec. 204. (a) The production and use of abundant supplies of high quality milk and dairy products are essential to the health and general welfare of the Nation; a dependable domestic source of supply of these foods in the form of high grade dairy herds and modern sanitary dairy equipment is important to the national defense; and an economically sound dairy industry affects beneficially the economy of the country as a whole. It is the policy of Congress to assure a stabilized annual production of adequate supplies of milk and dairy products; to promote the increased use of these essential foods; to improve the domestic source of supply of milk and butterfat by encouraging dairy farmers to develop efficient production units consisting of high-grade, disease-free cattle and modern sanitary equipment; and to stabilize the economy of dairy farmers at a level which will provide a fair return for their labor and investment when compared with the cost of things that farmers buy. (7 U. S. C. 1446b)

* * * * * * *

(c) In order to prevent the accumulation of excessive inventories of dairy products the Secretary of Agriculture shall undertake domestic disposal programs under authorities granted in the Agricultural Adjustment Act of 1938 and the Agricultural Act of 1949, as amended, or as otherwise authorized by law. (7 U. S. C. 1446c)]

SEC. 203. Whenever the price of either cottonseed or soybeans is supported under this Act, the price of the other shall be supported at such level as the Secretary determines will cause them to compete on equal terms on the market. (7 U. S. C. 1446 d) [18]

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[17] Sec. 202 added by sec. 204 (d) of the Agricultural Act of 1954. Sec. 504 of the Agricultural Act of 1958 substituted "1961" for "1958" in (a) and (b) and added a number of agencies at the end of the first sentence of (b). The Act of April 2, 1956, 70 Stat. 86, substituted "1958" for "1956".

[18] Sec. 203 added by sec. 601 of the Agricultural Act of 1956.

TITLE III—OTHER NONBASIC AGRICULTURAL COMMODITIES

SEC. 301. The Secretary is authorized to make available through loans, purchases, or other operations price support to producers for any nonbasic agricultural commodity not designated in title II at a level not in excess of 90 per centum of the parity price for the commodity. (7 U. S. C. 1447)

SEC. 302. Without restricting price support to those commodities for which a marketing quota or marketing agreement or order program is in effect, price support shall, insofar as feasible, be made available to producers of any storable nonbasic agricultural commodity for which such a program is in effect and who are complying with such program. The level of such support shall not be in excess of 90 per centum of the parity price of such commodity nor less than the level provided in the following table:

If the supply percentage as of the beginning of the marketing year is:	*The level of support shall be not less than the following percentage of the parity price:*
Not more than 102	90
More than 102 but not more than 104	89
More than 104 but not more than 106	88
More than 106 but not more than 108	87
More than 108 but not more than 110	86
More than 110 but not more than 112	85
More than 112 but not more than 114	84
More than 114 but not more than 116	83
More than 116 but not more than 118	82
More than 118 but not more than 120	81
More than 120 but not more than 122	80
More than 122 but not more than 124	79
More than 124 but not more than 126	78
More than 126 but not more than 128	77
More than 128 but not more than 130	76
More than 130	75

Provided, That the level of price support may be less than the minimum level provided in the foregoing table if the Secretary, after examination of the availability of funds for mandatory price support programs and consideration of the other factors specified in section 401 (b), determines that such lower level is desirable and proper. (7 U. S. C. 1448)

SEC. 303. In determining the level of price support for any nonbasic agricultural commodity under this title, particular consideration shall be given to the levels at which the prices of competing agricultural commodities are being supported. (7 U. S. C. 1449)

TITLE IV—MISCELLANEOUS

SUPPORT THROUGH CCC

SEC. 401. (a) The Secretary shall provide the price support authorized or required herein through the Commodity Credit Corporation and other means available to him. (7 U. S. C. 1421 (a).)

FACTORS

(b) Except as otherwise provided in this Act, the amounts, terms, and conditions of price support operations and the extent to which such operations are carried out, shall be determined or approved by the Secretary. The following factors shall be taken into consideration in determining, in the case of any commodity for which price support is discretionary, whether a price-support operation shall be undertaken and the level of such support and, in the case of any commodity for which price support is mandatory, the level of support in excess of the minimum level prescribed for such commodity: (1) the supply of the commodity in relation to the demand therefor, (2) the price levels at which other commodities are being supported and, in the case of feed grains, the feed values of such grains in relation to corn, (3) the availability of funds, (4) the perishability of the commodity, (5) the importance of the commodity to agriculture and the national economy, (6) the ability to dispose of stocks acquired through a price-support operation, (7) the need for offsetting temporary losses of export markets, and (8) the ability and willingness of producers to keep supplies in line with demand. (7 U. S. C. 1421 (b).)

COMPLIANCE WITH ACREAGE ALLOTMENTS, GOALS, AND MARKETING PRACTICES

(c) Compliance by the producer with acreage allotments, production goals and marketing practices (including marketing quotas when authorized by law), prescribed by the Secretary, may be required as a condition of eligibility for price support.[19] In administering any program for diverted acres the Secretary may make his regulations applicable on an appropriate geographical basis. Such regulations shall be administered (1) in semiarid or other areas where good husbandry requires maintenance of a prudent feed reserve in such manner as to permit, to the extent so required by good husbandry, the production of forage crops for storage and subsequent use either on the farm or in feeding operations of the farm operator, and (2) in areas declared to be disaster areas by the President under Public Law 875, Eighty-first Congress, in such manner as will most quickly restore the normal pattern of their agriculture. (7 U. S. C. 1421 (c).)

DETERMINATION OF SUPPORT LEVEL

(d) The level of price support for any commodity shall be determined upon the basis of its parity price as of the beginning of the marketing year or season in the case of any commodity marketed on a marketing year or season basis and as of January 1 in the case of any other commodity. (7 U. S. C. 1421 (d))

PROCESSOR PROGRAMS

(e) Whenever any price support or surplus removal operation for any agricultural commodity is carried out through purchases

[19] Balance of subsection added by sec. 206 of the Agricultural Act of 1954.

from or loans or payments to processors, the Secretary shall, to the extent practicable, obtain from the processors such assurances as he deems adequate that the producers of the agricultural commodity involved have received or will receive maximum benefits from the price support or surplus removal operation. (7 U. S. C. 1421 (e))[20]

SUPPORT AT INCREASED LEVEL

Sec. 402. Notwithstanding any other provision of this Act, price support at a level in excess of the maximum level of price support otherwise prescribed in this Act may be made available for any agricultural commodity if the Secretary determines, after a public hearing of which reasonable notice has been given, that price support at such increased level is necessary in order to prevent or alleviate a shortage in the supply of any agricultural commodity essential to the national welfare or in order to increase or maintain the production of any agricultural commodity in the interest of national security. The Secretary's determination and the record of the hearing shall be available to the public. (7 U. S. C. 1422)

ADJUSTMENTS FOR GRADE, ETC.

Sec. 403. Appropriate adjustments may be made in the support price for any commodity for differences in grade, type, staple, quality, location, and other factors. Such adjustments shall, so far as practicable, be made in such manner that the average support price for such commodity will, on the basis of the anticipated incidence of such factors, be equal to the level of support determined as provided in this Act. Middling seven-eighths-inch cotton shall be the standard grade for purposes of parity and price support.[21] Beginning with the 1959 crop, in adjusting the support price for cotton on the basis of grade, the Secretary shall establish separate price support rates for split grades and for full grades substantially reflecting relative values.[22] (7 U. S. C. 1423)

UTILIZATION OF SERVICES AND FACILITIES OF CCC

Sec. 404. The Secretary, in carrying out programs under section 32 of Public Law Numbered 320, Seventy-fourth Congress, approved August 24, 1935, as amended, and section 6 of the National School Lunch Act may utilize the services and facilities of the Commodity Credit Corporation (including but not limited to procurement by contract), and make advance payments to it. (7 U. S. C. 1424)

NONRECOURSE LOANS

Sec. 405. No producer shall be personally liable for any deficiency arising from the sale of the collateral securing any loan made under authority of this Act unless such loan was obtained through fraudu-

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20 Subsec. (e) added by sec. 207 of the Agricultural Act of 1954.

21 Effective with the 1961 crop, sec. 108 of the Agricultural Act of 1958, repeals this sentence and sec. 3 (a) of the Act of August 29, 1949, which provides: "Notwithstanding any other provision of law, Middling seven-eighths inch cotton shall be the standard grade for purposes of parity and price support. (7 U. S. C. 1301)

22 Sentence added by sec. 111 of the Agricultural Act of 1958.

lent representations by the producer. This provision shall not, however, be construed to prevent the Commodity Credit Corporation or the Secretary from requiring producers to assume liability for deficiencies in the grade, quality, or quantity of commodities stored on the farm or delivered by them, for failure properly to care for and preserve commodities, or for failure or refusal to deliver commodities in accordance with the requirements of the program. There is authorized to be included in the terms and conditions of any such nonrecourse loan a provision whereby on and after the maturity of the loan or any extension thereof Commodity Credit Corporation shall have the right to acquire title to the unredeemed collateral without obligation to pay for any market value which such collateral may have in excess of the loan indebtedness.[23] (7 U. S. C. 1425)

ADVANCE ANNOUNCEMENT

SEC. 406. The Secretary shall, insofar as practicable, announce the level of price support for field crops in advance of the planting season and for other agricultural commodities in advance of the beginning of the marketing year or season (January 1 in the case of commodities not marketed on a marketing year or season basis), but the level of price support so announced shall not exceed the estimated maximum level of price support specified in this Act, based upon the latest information and statistics available to the Secretary when such level of price support is announced; and the level of price support so announced shall not be reduced if the maximum level of price support when determined, is less than the level so announced. (7 U. S. C. 1426)

RESTRICTIONS ON SALES BY CCC

SEC. 407. The Commodity Credit Corporation may sell any farm commodity owned or controlled by it at any price not prohibited by this section. In determining sales policies for basic agricultural commodities or storable nonbasic commodities, the Corporation should give consideration to the establishing of such policies with respect to prices, terms, and conditions as it determines will not discourage or deter manufacturers, processors, and dealers from acquiring and carrying normal inventories of the commodity of the current crop. The Corporation shall not sell any basic agricultural commodity or storable nonbasic commodity at less than 5 per centum above the current support price for such commodity, plus reasonable carrying charges: *Provided*, That effective with the beginning of the marketing year for the 1961 crop, the Corporation shall not sell any upland or extra long staple cotton for unrestricted use at less than 15 per centum above the current support price for cotton plus reasonable carrying charges, except that the Corporation may, in an orderly manner and so as not to affect market prices unduly, sell for unrestricted use at the market price at the time of sale a number of bales of cotton equal to the number of bales by which the national marketing quota for such marketing year is reduced below the estimated domestic consumption and exports for such marketing year pursuant to the provisions of section 342 of the Agricultural Adjustment Act

[23] Sentence added by sec. 502 of the Agricultural Act of 1958.

of 1938, as amended.[24] The foregoing restrictions shall not apply to (A) sales for new or byproduct uses; (B) sales of peanuts and oilseeds for the extraction of oil; (C) sales for seed or feed if such sales will not substantially impair any price-support program; (D) sales of commodities which have substantially deteriorated in quality or as to which there is a danger of loss or waste through deterioration or spoilage; (E) sales for the purpose of establishing claims arising out of contract or against persons who have committed fraud, misrepresentation, or other wrongful acts with respect to the commodity; (F) sales for export; (G) sales of wool; and (H) sales for other than primary uses. Notwithstanding the foregoing, the Corporation, on such terms and conditions as the Secretary may deem in the public interest, shall make available any farm commodity or product thereof owned or controlled by it for use in relieving distress (1) in any area in the United States declared by the President to be an acute distress area because of unemployment or other economic cause if the President finds that such use will not displace or interfere with normal marketing of agricultural commodities and (2) in connection with any major disaster determined by the President to warrant assistance by the Federal Government under Public Law 875, Eighty-first Congress, as amended (42 U. S. C. 1855). Except on a reimbursable basis, the Corporation shall not bear any costs in connection with making such commodity available beyond the cost of the commodities to the Corporation in store and the handling and transportation costs in making delivery of the commodity to designated agencies at one or more central locations in each State.[25] Nor shall the foregoing restrictions apply to sales of commodities the disposition of which is desirable in the interest of the effective and efficient conduct of the Corporation's operations because of the small quantities involved, or because of age, location or questionable continued storability, but such sales shall be offset by such purchases of commodities as the Corporation determines are necessary to prevent such sales from substantially impairing any price-support program, but in no event shall the purchase price exceed the then current support price for such commodities.[26] For the purposes of this section, sales for export shall not only include sales made on condition that the identical commodities sold be exported, but shall also include sales made on condition that commodities of the same kind and of comparable value or quantity be exported, either in raw or processed form.[27] (7 U. S. C. 1427)

DEFINITIONS

SEC. 408. For the purposes of this Act—

STORABLE COMMODITIES

(a) A commodity shall be considered storable upon determination by the Secretary that, in normal trade practice, it is stored for substantial periods of time and that it can be stored under the price-

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24 Proviso added by sec. 109 of the Agricultural Act of 1958.

25 The two preceding sentences were added by sec. 301 of the Agricultural Trade Development and Assistance Act of 1954 (p. 172).

26 This sentence was added by the Act of July 29, 1954, 68 Stat. 583.

27 This sentence was added by the Act of January 28, 1956, 70 Stat. 6.

support program without excessive loss through deterioration or spoilage or without excessive cost for storage for such periods as will permit its disposition without substantial impairment of the effectiveness of the price-support program. (7 U. S. C. 1428 (a))

COOPERATOR

(b) A "cooperator" with respect to any basic agricultural commodity shall be a producer on whose farm the acreage planted to the commodity does not exceed the farm acreage allotment for the commodity under title III of the Agricultural Adjustment Act of 1938, as amended, or in the case of price support for corn or wheat to a producer outside the commercial corn-producing or wheat-producing area, a producer who complies with conditions of eligibility prescribed by the Secretary.[28] For the purpose of this subsection, a producer shall not be deemed to have exceeded his farm acreage allotment unless such producer knowingly exceeded such allotment. (7 U. S. C. 1428 (b)).[29]

BASIC AGRICULTURAL COMMODITY

(c) A "basic agricultural commodity" shall mean corn, cotton, peanuts, rice, tobacco, and wheat, respectively. (7 U. S .C. 1428 (c))

NONBASIC AGRICULTURAL COMMODITY

(d) A "nonbasic agricultural commodity" shall mean any agricultural commodity other than a basic agricultural commodity. (7 U. S. C. 1428 (d))

SUPPLY PERCENTAGE

(e) The "supply percentage" as to any commodity shall be the percentage which the estimated total supply is of the normal supply as determined by the Secretary from the latest available statistics of the Department of Agriculture as of the beginning of the marketing year for the commodity. (7 U. S. C. 1428 (e))

TOTAL SUPPLY

(f) "Total supply"[30] of any nonbasic agricultural commodity for any marketing year shall be the carry-over at the beginning of such marketing year, plus the estimated production of the commodity in the United States during the calendar year in which such marketing year begins and the estimated imports of the commodity into the United States during such marketing year. (7 U. S. C. 1428 (f))

CARRY-OVER

(g) "Carry-over"[30] of any nonbasic agricultural commodity for any marketing year shall be the quantity of the commodity on hand in the United States at the beginning of such marketing year, not

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[28] The words "or wheat" and "or wheat-producing" were added by sec. 209 of the Agricultural Act of 1954.

[29] See sec. 374 (c) of the Agricultural Adjustment Act of 1938 as to adjusting planted acreage.

including any part of the crop or production of such commodity which was produced in the United States during the calendar year then current. The carry-over of any such commodity may also include the quantity of such commodity in processed form on hand in the United States at the beginning of such marketing year, if the Secretary determines that the inclusion of such processed quantity of the commodity is necessary to effectuate the purposes of this Act. (7 U. S. C. 1428 (g))

NORMAL SUPPLY

(h) "Normal supply"[30] of any nonbasic agricultural commodity for any marketing year shall be (1) the estimated domestic consumption of the commodity for the marketing year for which such normal supply is being determined, plus (2) the estimated exports of the commodity for such marketing year, plus (3) an allowance for carry-over. The allowance for carry-over shall be the average carry-over of the commodity for the five marketing years immediately preceding the marketing year in which such normal supply is determined, adjusted for surpluses or deficiencies caused by abnormal conditions, changes in marketing conditions, or the operation of any agricultural program. In determining normal supply, the Secretary shall make such adjustments for current trends in consumption and for unusual conditions as he may deem necessary. (7 U. S. C. 1428 (h))

MARKETING YEAR

(i) "Marketing year"[30] for any nonbasic agricultural commodity means any period determined by the Secretary during which substantially all of a crop or production of such commodity is normally marketed by the producers thereof. (7 U. S. C. 1428 (i))

TERMS DEFINED IN AGRICULTURAL ADJUSTMENT ACT OF 1938

(j) Any term defined in the Agricultural Adjustment Act of 1938, shall have the same meaning when used in this Act. (7 U. S. C. 1428 (j))

SEC. 409. [This section contains amendments to the Agricultural Adjustment Act of 1938. These amendments are included in that act, as it appears in this compilation.]

SEC. 410. [This section contains an amendment to section 4 of the act of March 8, 1938 (15 U. S. C. 713a–4) relating to the borrowing power of Commodity Credit Corporation (p. 151).]

SEC. 411. [This section contains an amendment to section 32 of Pub. L. 320, 74th Congress (p. 174).]

DETERMINATIONS BY SECRETARY

SEC. 412. Determinations made by the Secretary under this Act shall be final and conclusive: *Provided*, That the scope and nature of such determinations shall not be inconsistent with the provisions of the Commodity Credit Corporation Charter Act. (7 U. S. C. 1429)

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[30] See sec. 301 (b) of the Agricultural Adjustment Act of 1938 for definitions applicable to basic commodities.

WHEN PRICE SUPPORT PROVISIONS EFFECTIVE

SEC. 413. This Act shall not be effective with respect to price support operations for any agricultural commodity for any marketing year or season commencing prior to January 1, 1950, except to the extent that the Secretary of Agriculture shall, without reducing price support theretofore undertaken or announced, elect to apply the provisions of this Act. (7 U. S. C. 1430)

REPEAL OF PREVIOUS LEGISLATION

SEC. 414. Section 302 of the Agricultural Adjustment Act of 1938, as amended, and any provision of law in conflict with the provisions of this Act are hereby repealed. (7 U. S. C. 1421 note)

SEC. 415. [This section contains amendments to the Agricultural Act of 1948 and the Agricultural Adjustment Act of 1938.]

DISPOSITION OF COMMODITIES TO PREVENT WASTE

SEC. 416.[31] In order to prevent the waste of commodities acquired through price-support operations by the Commodity Credit Corporation before they can be disposed of in normal domestic channels without impairment of the price-support program or sold abroad at competitive world prices, the Commodity Credit Corporation is authorized, on such terms and under such regulations as the Secretary may deem in the public interest: (1) upon application, to make such commodities available to any Federal agency for use in making payment for commodities not produced in the United States; (2) to barter or exchange such commodities for strategic or other materials as authorized by law; (3) in the case of food commodities to donate such commodities to the Bureau of Indian Affairs and to such State, Federal, or private agency or agencies as may be designated by the proper State or Federal authority and approved by the Secretary, for use in the United States in nonprofit school-lunch programs, in nonprofit summer camps for children,[32] in the assistance of needy persons, and in charitable institutions, including hospitals, to the extent that needy persons are served; and (4) to donate any such food commodities in excess of anticipated disposition under (1), (2), and (3) above to nonprofit voluntary agencies registered with the Committee on Voluntary Foreign Aid of the Foreign Operations Administration or other appropriate department or agency of the Federal Government and intergovernmental organizations for use in the assistance of needy persons outside the United States. In the case of (3) and (4) above the Secretary shall obtain such assurance as he deems necessary that the recipients thereof will not diminish their normal expenditures for food by reason of such donation. In order to facilitate the appropriate disposal of such commodities, the Secretary may from time to time estimate and announce the quantity of such commodities which he anticipates will become available for distribution under (3) and (4) above. The Commodity Credit

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[31] See also sec. 9 of the Act of September 6, 1958, and the Department of the Interior and Related Agencies Appropriation Act, 1959 (both on p. 177), providing for distribution of commodities under sec. 416 to overseas areas under the jurisdiction or administration of the United States.

[32] The words "in nonprofit summer camps for children," were added by the Act of July 2, 1958, Pub. L. 85-483, 72 Stat. 286.

Corporation may pay, with respect to commodities disposed of under this section, reprocessing, packaging, transporting, handling, and other charges accruing up to the time of their delivery to a Federal agency or to the designated State or private agency, in the case of commodities made available for use within the United States, or their delivery free alongside ship or free on board export carrier at point of export, in the case of commodities made available for use outside the United States. In addition, in the case of food commodities disposed of under this section, the Commodity Credit Corporation may pay the cost of processing such commodities into a form suitable for home or institutional use, such processing to be accomplished through private trade facilities to the greatest extent possible. For the purpose of this section the terms "State" and "United States" include the District of Columbia and any Territory or possession of the United States. (7 U. S. C. 1431)[33]

[FLOUR AND CORNMEAL DONATIONS

Public Law 85–683

August 19, 1958

AN ACT

Authorizing Commodity Credit Corporation to purchase flour and cornmeal and donating same for certain domestic and foreign purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That at any time Commodity Credit Corporation has wheat or corn available for donation pursuant to clauses (3) or (4) of section 416 of the Agricultural Act of 1949, as amended, section 210 of the Agricultural Act of 1956, or title II of the Agricultural Trade Development and Assistance Act, as amended, the Corporation, in lieu of processing all or any part of such wheat or corn into flour or meal, may purchase flour or meal in quantities not to exceed the equivalent of such wheat or corn so available on the date of purchase and donate such flour and meal pursuant to clauses (3) or (4) of said section 416 and to said section 210 and make such flour or meal available to the President, pursuant to said title II and may sell, without regard to the provisions of section 407 of the Agricultural Act of 1949, as amended, a quantity of wheat and corn not to exceed that which is equivalent to the quantity of flour and meal so purchased. (72 Stat. 635; 7 U. S. C. 1431 note)]

SEC. 417. (a) Section 41 of the Farm Credit Act of 1933 (U. S. C., title 12, sec. 1134c) is amended by adding at the end thereof the following:

"Notwithstanding any limitations or conditions imposed by law, but subject to the availability of funds, each Bank for Cooperatives shall have power and authority to make separate loans to cooperative associations as defined in the Agricultural Marketing Act, as

[33] The provisions of this section were substituted for the previous provisions by sec. 302 of the Agricultural Trade Development and Assistance Act of 1954. See also sec. 305 of that act (p. 173), providing for the identification of stocks disposed of under sec. 416 as being furnished by the people of the United States. The next to the last sentence of this section was added by the Agricultural Act of 1956, 70 Stat. 203. See also sec. 210 of the Agricultural Act of 1956 as to donations to penal institutions (p. 149).

amended, for the purpose of financing the construction of structures for the storage of agricultural commodities (other than structures to provide refrigerated cold storage or structures in areas in which existing privately owned storage facilities for the commodity concerned are adequate) in amounts up to a maximum of 80 per centum of the cost of such structures, as approved by the Bank for Cooperatives to whom application is made for the loan: *Provided*, That the cooperative association which has applied for any loan shall have furnished to the Bank for Cooperatives an appropriate commitment from the Commodity Credit Corporation that the Commodity Credit Corporation will lease or guarantee utilization of not less than 75 per centum of the storage space contained in such structures when completed for a period of at least three years if such structures are not additions to existing structures, or two years if such structures are additions to existing structures."

(b) Section 34 of the Farm Credit Act of 1933 (U. S. C., title 12 sec. 1134j) is amended by adding at the end thereof the following:

"Notwithstanding any limitations or conditions imposed by law, but subject to the availability of funds, the Central Bank for Cooperatives shall have power and authority to make separate loans to cooperative associations as defined in the Agricultural Marketing Act, as amended, for the purpose of financing the construction of structures for the storage of agricultural commodities (other than structures to provide refrigerated cold storage or structures located in areas in which existing privately owned storage facilities for the commodity concerned are adequate) in amounts up to a maximum of 80 per centum of the cost of such structures, as approved by such bank: *Provided*, That the cooperative association which has applied for any loan shall have furnished to such bank an appropriate commitment from the Commodity Credit Corporation that the Commodity Credit Corporation will lease or guarantee utilization of not less than 75 per centum of the storage space contained in such structures when completed for a period of at least three years if such structures are not additions to existing structures, or two years if such structures are additions to existing structures."[34]

SECS. 418 and 419. [These sections contain amendments to the Agricultural Adjustment Act of 1938. These amendments are included in that act as it appears in this compilation.]

PRICE SUPPORT FOR COTTONSEED

SEC. 420. Any price support program in effect on cottonseed or any of its products shall be extended to the same seed and products of the cottons defined under section 347 (a) of the Agricultural Adjustment Act of 1938, as amended. (7 U. S. C. 1432)[35]

TITLE V—AGRICULTURAL WORKERS

[This title, which was added by the Act of July 12, 1951, 65 Stat. 119, 7 U. S. C. 1461–1468, contains provisions authorizing the Secretary of Labor to enter into arrangements for the recruiting of agricultural workers from Mexico.]

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[34] See also sec. 4 (h) of the Commodity Credit Corporation Act (p. 111), which provides for loans by the Corporation to grain growers to finance the construction or purchase of storage facilities.

[35] This section was added by the act of July 17, 1952, 66 Stat. 758, 759.

AGRICULTURAL ACT OF 1954 [1]

AN ACT

To provide for greater stability in agriculture; to augment the marketing and disposal of agricultural products; and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I—SET ASIDE OF AGRICULTURAL COMMODITIES

SEC. 101. The Commodity Credit Corporation shall, as rapidly as the Secretary of Agriculture shall determine to be practicable, set aside within its inventories not more than the following maximum quantities and not less than the following minimum quantities of agricultural commodities or products thereof heretofore or hereafter acquired by it from 1954 and prior years' crops and production in connection with its price support operations:

Commodity	Maximum quantity	Minimum quantity
Wheat (bushels)	500,000,000	400,000,000
Upland cotton (bales)	4,000,000	3,000,000
Cottonseed oil (pounds)	500,000,000	0
Butter (pounds)	200,000,000	0
Nonfat dry milk solids (pounds)	300,000,000	0
Cheese (pounds)	150,000,000	0

Such quantities shall be known as the "commodity set-aside". (7 U. S. C. 1741)

SEC. 102. Quantities of commodities shall not be included in the commodity set-aside which have an aggregate value in excess of $2,500,000,000. The value of the commodities placed in the commodity set-aside, for the purpose of this section, shall be the Corporation's investment in such commodities as of the date they are included in the commodity set-aside, as determined by the Secretary. (7 U. S. C. 1742)

SEC. 103. (a) Such commodity set-aside shall be reduced by disposals made in accordance with the directions of the President as follows:

(1) Donation, sale, or other disposition for disaster or other relief purposes outside the United States pursuant to and subject to the limitations of title II of the Agricultural Trade Development and Assistance Act of 1954;

(2) Sale or barter (including barter for strategic materials) to develop new or expanded markets for American agricultural commodities, including but not limited to disposition pursuant to and subject to the limitations of title I of the Agricultural Trade Development and Assistance Act of 1954;

(3) Donation to school-lunch programs;

[1] Approved August 28, 1954, 68 Stat. 897.

(4) Transfer to the national stockpile established pursuant to the Act of June 7, 1939, as amended (50 U. S. C. 98–98h), without reimbursement from funds appropriated for the purposes of that Act;

(5) Donation, sale, or other disposition for research, experimental, or educational purposes;

(6) Donation, sale, or other disposition for disaster relief purposes in the United States or to meet any national emergency declared by the President; and

(7) Sale for unrestricted use to meet a need for increased supplies at not less than 105 per centum of the parity price in the case of agricultural commodities and a price reflecting 105 per centum of the parity price of the agricultural commodity in the case of products of agricultural commodities.

The President shall prescribe such terms and conditions for the disposal of commodities in the commodity set-aside as he determines will provide adequate safeguards against interference with normal marketings of the supplies of such commodities outside the commodity set-aside. Strategic materials acquired by the Commodity Credit Corporation under paragraph (2) of this subsection shall be transferred to the national stockpile established pursuant to the Act of June 7, 1939, as amended, and the Commodity Credit Corporation shall be reimbursed for the value of the commodities bartered for such strategic materials from funds appropriated pursuant to section 8 of such Act of June 7, 1939, as amended. For the purpose of such reimbursement, the value of any commodity so bartered shall be the lower of the domestic market price or the Commodity Credit Corporation's investment therein as of the date of such barter, as determined by the Secretary of Agriculture. (7 U. S. C. 1743 (a))

(b) The quantity of any commodity in the commodity set-aside shall be reduced to the extent that the Commodity Credit Corporation inventory of such commodity is reduced, by natural or other cause beyond the control of the Corporation, below the quantity then charged to the commodity set-aside. (7 U. S. C. 1743 (b))

Sec. 104. (a) The Corporation shall have authority to sell, without regard to section 103 (a) (7) hereof, any commodity covered by the commodity set-aside for the purpose of rotating stocks or consolidating inventories, any such sale to be offset by purchase of the same commodity in a substantially equivalent quantity or of a substantially equivalent value. (7 U. S. C. 1744 (a))

(b) Dispositions pursuant to this title shall not be subject to the pricing limitations of section 407 of the Agricultural Act of 1949, as amended. (7 U. S. C. 1744 (b))

Sec. 105. The quantity of any commodity in the commodity set-aside or transferred from the set-aside to the national stockpile established pursuant to the Act of June 7, 1939, as amended (50 U. S. C. 98–98h) shall be excluded from the computation of "carryover" for the purpose of determining the price support level for such commodity under the Agricultural Act of 1949, as amended, and related legislation, but shall be included in the computation of total supplies for purposes of acreage allotments and marketing quotas under the Agricultural Adjustment Act of 1938, as amended, and related legislation. Until such time as the commodity set-aside has been completed, such quantity of the commodity as the Secretary shall deter-

mine between the maximum and minimum quantities specified in section 101 of this Act shall be excluded from the computations of "carryover" for the purpose of determining the price support level, but shall be included in the computation of total supplies for purposes of acreage allotments and marketing quotas, for the 1955 crop of the commodity, notwithstanding that the quantity so excluded may not have been acquired by the Corporation and included in the commodity set-aside. (7 U. S. C. 1745)

SEC. 106. The Commodity Credit Corporation shall keep such records and accounts as may be necessary to show, for each commodity set-aside, the initial and current composition, value (in accordance with section 102), current investment, quantity disposed of, method of disposition, and amounts received on disposition. (7 U. S. C. 1746)

SEC. 107. In order to make payment to the Commodity Credit Corporation for any commodities transferred to the national stockpile pursuant to section 103 (a) (4) of this Act, there are hereby authorized to be appropriated amounts equal to the value of any commodities so transferred. The value of any commodity so transferred, for the purpose of this section, shall be the lower of the domestic market price or the Commodity Credit Corporation's investment therein as of the date of transfer to the stockpile, as determined by the Secretary of Agriculture. (7 U. S. C. 1747)

TITLE II—AMENDMENTS TO AGRICULTURAL ACT OF 1949, AS AMENDED, AND RELATED LEGISLATION

[This title contains amendments to the Agricultural Act of 1949, which are incorporated in that Act as contained in this compilation, and amendments to related legislation.]

TITLE III—AMENDMENTS TO AGRICULTURAL ADJUSTMENT ACT OF 1938, AND RELATED LEGISLATION

[This title contains amendments to the Agricultural Act of 1949 and the Agricultural Adjustment Act of 1938, which are incorporated in those Acts contained in this compilation, and amendments to related legislation.]

TITLE IV—AMENDMENTS TO AGRICULTURAL MARKETING AGREEMENT ACT OF 1937

[This title contains amendments to the Agricultural Marketing Agreement Act of 1937, which are incorporated in that Act as contained in this compilation.]

TITLE V—AMENDMENTS TO SOIL CONSERVATION AND DOMESTIC ALLOTMENT ACT

[This title contains amendments to the Soil Conservation and Domestic Allotment Act, which are incorporated in that Act as contained in this compilation.]

TITLE VI—AGRICULTURAL ATTACHES

SEC. 601. For the purpose of encouraging and promoting the marketing of agricultural products of the United States and assisting American farmers, processors, distributors, and exporters to adjust their operations and practices to meet world conditions, the Secretary of Agriculture shall acquire information regarding the competition and demand for United States agricultural products, the marketing and distribution of said products in foreign countries and shall be responsible for the interpretation and dissemination of such information in the United States and shall make investigations abroad regarding the factors affecting and influencing the export of United States agricultural products, and shall conduct abroad any other activities including the demonstration of standards of quality for American agricultural products for which the Department of Agriculture now has or in the future may have such standards, as he deems necessary. Nothing contained herein shall be construed as prohibiting the Department of Agriculture from conducting abroad any activity for which authority now exists. (7 U. S. C. 1761)

SECS. 602 to 608. [These sections provide for the appointment of agricultural attaches.]

TITLE VII—NATIONAL WOOL ACT OF 1954

SEC. 701. This title may be cited as the "National Wool Act of 1954."

SEC. 702. It is hereby recognized that wool is an essential and strategic commodity which is not produced in quantities and grades in the United States to meet the domestic needs and that the desired domestic production of wool is impaired by the depressing effects of wide fluctuations in the price of wool in the world markets. It is hereby declared to be the policy of Congress, as a measure of national security and in promotion of the general economic welfare, to encourage the annual domestic production of approximately three hundred million pounds of shorn wool, grease basis, at prices fair to both producers and consumers in a manner which will have the least adverse effects upon foreign trade. (7 U. S. C. 1781)

SEC. 703. The Secretary of Agriculture shall, through the Commodity Credit Corporation, support the prices of wool and mohair, respectively, to the producers thereof by means of loans, purchases, payments, or other operations. Such price support shall be limited to wool and mohair marketed during the period beginning April 1, 1955, and ending March 31, 1962.[2] The support price for shorn wool shall be at such incentive level as the Secretary, after consultation with producer representatives, and after taking into consideration prices paid and other cost conditions affecting sheep production, determines to be necessary in order to encourage an annual production consistent with the declared policy of this title: *Provided*, That the support price for shorn wool shall not exceed 110 per centum of the parity price therefor. If the support price so determined does not exceed 90 per centum of the parity price for shorn wool, the support

[2] "1962" substituted for "1958" by sec. 401 of the Agricultural Act of 1958.

price for shorn wool shall be at such level, not in excess of 90 per centum nor less than 60 per centum of the parity price therefor, as the Secretary determines necessary in order to encourage an annual production of approximately three hundred and sixty million pounds of shorn wool. The support prices for pulled wool and for mohair shall be established at such levels, in relationship to the support price for shorn wool, as the Secretary determines will maintain normal marketing practices for pulled wool, and as the Secretary shall determine is necessary to maintain approximately the same percentage of parity for mohair as for shorn wool. The deviation of mohair support prices shall not be calculated so as to cause it to rise or fall more than 15 per centum above or below the comparable percentage of parity at which shorn wool is supported. Notwithstanding the foregoing, no price support shall be made available, other than through payments, at a level in excess of 90 per centum of the parity price for the commodity. The Secretary shall, to the extent practicable, announce the support price levels for wool and mohair sufficiently in advance of each marketing year as will permit producers to plan their production for such marketing year. (7 U. S. C. 1782)

SEC. 704. If payments are utilized as a means of price support, the payments shall be such as the Secretary of Agriculture determines to be sufficient, when added to the national average price received by producers, to give producers a national average return for the commodity equal to the support price level therefor: *Provided*, That the total of all such payments made under this Act shall not at any time exceed an amount equal to 70 per centum of the accumulated totals, as of the same date, of the gross receipts from duties[3] collected on and after January 1, 1953, on all articles subject to duty under schedule 11 of the Tariff Act of 1930, as amended. The payments shall be made upon wool and mohair marketed by the producers thereof, but any wool or mohair produced prior to January 1, 1955, shall not be the subject of payments. The payments shall be at such rates for the marketing year or periods thereof as the Secretary determines will give producers the support price level as herein provided. Payments to any producer need not be made if the Secretary determines that the amount of the payment to the producer or all producers is too small to justify the cost of making such payments. The Secretary may make the payment to producers through the marketing agency to or through whom the producer marketed his wool or mohair: *Provided*, That such marketing agency agrees to receive and promptly distribute the payments on behalf of such producers. In case any person who is entitled to any such payment dies, becomes incompetent, or disappears before receiving such payment, or is succeeded by another who renders or completes the required performance, the payment shall, without regard to any other provisions of law, be made as the Secretary may determine to be fair and reasonable in all the circumstances and provided by regulation. (7 U. S. C. 1783)

SEC. 705. For the purpose of reimbursing the Commodity Credit Corporation for any expenditures made by it in connection with payments to producers under this title, there is hereby appropriated for each fiscal year beginning with the fiscal year ending June 30,

1956, an amount equal to the total of expenditures made by the Corporation during the preceding fiscal year and to any amounts expended in prior fiscal years not previously reimbursed: *Provided, however*, That such amounts appropriated for any fiscal year shall not exceed 70 per centum of the gross receipts from duties[3] collected during the period January 1 to December 31, both inclusive, preceding the beginning of each such fiscal year on all articles subject to duty under schedule 11 of the Tariff Act of 1930, as amended. For the purposes of the appraisal under the Act of March 8, 1938, as amended (15 U. S. C. 713a–1), the Commodity Credit Corporation shall establish on its books an account receivable in an amount equal to any amount expended by Commodity Credit Corporation in connection with payments pursuant to this title which has not been reimbursed from appropriations made hereunder. (7 U. S. C. 1784)

SEC. 706. Except as otherwise provided in this title, the amounts, terms, and conditions of the price support operations and the extent to which such operations are carried out shall be determined or approved by the Secretary of Agriculture. The Secretary may, in determining support prices and rates of payment, make adjustments in such prices or rates for differences in grade, quality, type, location, and other factors to the extent he deems practicable and desirable. Determinations by the Secretary under this title shall be final and conclusive. The facts constituting the basis for any operation, payment, or amount thereof when officially determined in conformity with applicable regulations prescribed by the Secretary shall be final and conclusive and shall not be reviewable by any other officer or agency of the Government. (7 U. S. C. 1785)

SEC. 707. The term "marketing year" as used in this title means the twelve-month period beginning April 1 of each calendar year or, for either wool or mohair, such other period, or periods for prescribed areas, as the Secretary may determine to be desirable to effectuate the purpose of this title. (7 U. S. C. 1786)

SEC. 708. The Secretary of Agriculture is authorized to enter into agreements with, or to approve agreements entered into between, marketing cooperatives, trade associations, or others engaged or whose members are engaged in the handling of wool, mohair, sheep, or goats or the products thereof for the purpose of developing and conducting on a National, State, or regional basis advertising and sales promotion programs for wool, mohair, sheep, or goats or the products thereof. Provision may be made in such agreement to obtain the funds necessary to defray the expenses incurred thereunder through pro rata deductions from the payments made under section 704 of this title to producers within the production area he determines will be benefited by the agreement and for the assignment and transfer of the amounts so deducted to the person or agency designated in the agreement to receive such amounts for expenditure in accordance with the terms and conditions of the agreement. No agreement containing such a provision for defraying expenses through deductions shall become effective until the Secretary determines that at least two-thirds of the producers who, dur-

[3] Secs. 402 and 403 of the Agricultural Act of 1958 deleted "specific" prior to and "(whether or not such specific duties are parts of compounded rates)" following, the word duties.

ing a representative period determined by the Secretary, have been engaged, within the production area he determines will be benefited by the agreement, in the production for market of the commodity specified therein approve or favor such agreement or that producers who, during such representative period have produced at least two-thirds of the volume of such commodity produced within the area which will be benefited by such agreement, approve or favor such agreement. Approval or disapproval by cooperative associations shall be considered as approval or disapproval by the producers who are members of, stockholders in, or under contract with such co-operative association of producers. The Secretary may conduct a referendum among producers to ascertain their approval or favor. The requirements of approval or favor shall be held to be complied with if two-thirds of the total number of producers, or two-thirds of the total volume of production, as the case may be, represented in such referendum, indicate their approval or favor. (7 U. S. C. 1787)

SEC. 709. Section 201 of the Agricultural Act of 1949 (7 U. S. C., sec. 1446) is amended effective April 1, 1955, (i) by deleting from the first sentence thereof the phrase "wool (including mohair)," and (ii) by deleting subsection (a) thereof relating to the support of wool and mohair.

SEC. 710 [This section contains an amendment to the Commodity Exchange Act.]

AGRICULTURAL ACT OF 1956 [1]

AN ACT

To enact the Agricultural Act of 1956.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Agricultural Act of 1956".

TITLE I—SOIL BANK ACT

[The provisions of this title are to be found beginning on p. 95.]

TITLE II—SURPLUS DISPOSAL

PROGRAM OF ORDERLY LIQUIDATION

SEC. 201. (a) The Commodity Credit Corporation shall, as rapidly as possible consistent with its existing authority, the operation of the price support program, and orderly liquidation, dispose of all stocks of agricultural commodities held by it.

(b) The Secretary shall submit to Congress within ninety days after the enactment of this Act detailed programs, with recommendations for any additional legislation needed to carry out such programs, (1) for the disposition of surplus commodities as required by subsection (a) above; (2) for a food stamp plan or similar program for distribution through States (including the District of Columbia, the Territories, Puerto Rico and the Virgin Islands) and local units of Government of future surplus production to needy persons in the United States, its Territories, and possessions, so as to prevent the accumulation of commodities in the hands of the Commodity Credit Corporation; and (3) for strategic stockpiling of foodstuffs and other agricultural products (A) inside the United States and (B) outside the United States as authorized in section 415 of the Mutual Security Act of 1954. The Secretary shall report annually on his operations under subsection (a) and such reports shall show—

(1) the quantities of surplus commodities on hand;

(2) the methods of disposition utilized and the quantities disposed of during the preceding twelve months;

(3) the methods of disposition to be utilized and the estimated quantities that can be disposed of during the succeeding twelve months;

(4) a detailed program for the expansion of markets for surplus agricultural commodities through marketing and utilization research and improvement of marketing facilities; and

(5) recommendations for additional legislation necessary to accomplish the purposes of this section. (7 U. S. C. 1851)

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[1] Approved May 28, 1956, 70 Stat. 188.

EXTRA-LONG STAPLE COTTON

SEC. 202. (a) Hereafter the quota for cotton having a staple length of one and one-eighth inches or more, established September 20, 1939, pursuant to section 22 of the Agricultural Adjustment Act of 1933, as amended, shall apply to the same grades and staple lengths included in the quota when such quota was initially established. Such quota shall provide for cotton having a staple length of one and eleven-sixteenths inches and longer, and shall establish dates for the quota year which will recognize and permit entry to conform to normal marketing practices and requirements for such cotton.

(b) Beginning not later than August 1, 1956, the Commodity Credit Corporation is directed to sell for export at competitive world prices its stocks of domestically produced extra long staple cotton on hand on the date of enactment of this Act. The amount offered and the price accepted by the Commodity Credit Corporation shall be such as to dispose of such quantity in an orderly manner and within a reasonable period of time. (7 U. S. C. 1852)

EXPORT SALES PROGRAM FOR COTTON

SEC. 203. In furtherance of the current policy of the Commodity Credit Corporation of offering surplus agricultural commodities for sale for export at competitive world prices, the Commodity Credit Corporation is directed to use its existing powers and authorities immediately upon the enactment of this Act to encourage the export of cotton by offering to make cotton available at prices not in excess of the level of prices at which cottons of comparable qualities are being offered in substantial quantity by other exporting countries and, in any event, for the cotton marketing year beginning August 1, 1956, at prices not in excess of the minimum prices (plus carrying charges, beginning October 1, 1956, as established pursuant to Section 407 of the Agricultural Act of 1949) at which cottons of comparable qualities were sold under the export program announced by the United States Department of Agriculture on August 12, 1955. The Commodity Credit Corporation may accept bids in excess of the maximum prices specified herein but shall not reject bids at such maximum prices unless a higher bid is received for the same cotton. Cottons of qualities not comparable to those of cottons sold under the program announced on August 12, 1955, shall be offered at prices not in excess of the maximum prices prescribed hereunder for cottons of qualities comparable to those of cottons sold under such program, with appropriate adjustment for differences in quality. Such quantities of cotton shall be sold as will reestablish and maintain the fair historical share of the world market for United States cotton, said volume to be determined by the Secretary of Agriculture. (7 U. S. C. 1853)

COTTON EXPORT PROGRAM

[Agricultural Act of 1958—Sec. 110. Nothing in this Act shall be construed to affect or modify the provisions of section 203 of the Agricultural Act of 1956, and any cotton owned or acquired by the

Commodity Credit Corporation under any price support program may be used for the purpose of carrying out the cotton export program provided for in section 203 of the Agricultural Act of 1956. (72 Stat. 993, 7 U. S. C. 1853]

AGREEMENTS LIMITING IMPORTS

SEC. 204. The President may, whenever he determines such action appropriate, negotiate with representatives of foreign governments in an effort to obtain agreements limiting the export from such countries and the importation into the United States of any agricultural commodity or product manufactured therefrom or textiles or textile products, and the President is authorized to issue regulations governing the entry or withdrawal from warehouse of any such commodity, product, textiles, or textile products to carry out any such agreement. Nothing herein shall affect the authority provided under section 22 of the Agricultural Adjustment Act (of 1933) as amended. (7 U. S. C. 1854)

APPROPRIATION TO SUPPLEMENT SECTION 32 FUNDS

SEC. 205. There is hereby authorized to be appropriated for each fiscal year, beginning with the fiscal year ending June 30, 1957, the sum of $500,000,000 to enable the Secretary of Agriculture to further carry out the provisions of section 32, Public Law 320, Seventy-fourth Congress, as amended (7 U. S. C. 612c), subject to all provisions of law relating to the expenditure of funds appropriated by such section, except that up to 50 per centum of such $500,000,000 may be devoted during any fiscal year to any one agricultural commodity or the products thereof. (7 U. S. C. 1855)

TRANSFER OF BARTERED MATERIALS TO SUPPLEMENTAL STOCKPILE

SEC. 206. (a) Strategic and other materials acquired by the Commodity Credit Corporation as a result of barter or exchange of agricultural commodities or products, unless acquired for the national stockpile established pursuant to the Strategic and Critical Materials Stock Piling Act (50 U. S. C. 98–98h), or for other purposes shall be transferred to the supplemental stockpile established by section 104 (b) of the Agricultural Trade Development and Assistance Act of 1954 (7 U. S. C. 1704); but no strategic or critical material shall be acquired by the Commodity Credit Corporation as a result of such barter or exchange, except for such national stockpile, for such supplemental stockpile, for foreign economic or military aid or assistance programs, or for offshore construction programs.[2]

(b) Strategic materials acquired by the Commodity Credit Corporation as a result of barter or exchange of agricultural commodities or products may be entered, or withdrawn from warehouse, free of duty.

(c) In order to reimburse the Commodity Credit Corporation for materials transferred to the supplemental stockpile there are hereby

[2] The material following the semicolon was added by the Act of September 6, 1958, Pub. L. 85-931, 72 Stat. 1791.

authorized to be appropriated amounts equal to the value of any materials so transferred. The value of any such material for the purpose of this subsection, shall be the lower of the domestic market price or the Commodity Credit Corporation's investment therein as of the date of such transfer, as determined by the Secretary of Agriculture. (7 U. S. C. 1856)

SURPLUS DISPOSAL ADMINISTRATOR

SEC. 207. The Secretary of Agriculture is authorized to appoint an agricultural surplus disposal administrator, at a salary rate of not exceeding $15,000 per annum, whose duties shall include such responsibility for activities of the Department, including those of the Commodity Credit Corporation, relating to the disposal of surplus agricultural commodities as the Secretary may direct. (7 U. S. C. 1857)

PAYMENT OF OCEAN FREIGHT

SEC. 208. [This section contains amendments to the Agricultural Trade Development and Assistance Act of 1954, which are incorporated in that Act as contained in this compilation.]

COMMISSION TO RECOMMEND LEGISLATION PROVIDING FOR INCREASED INDUSTRIAL USE OF AGRICULTURAL PRODUCTS

SEC. 209. (a) (1) There is hereby established a bipartisan Commission on Increased Industrial Use of Agricultural Products (hereafter referred to as "the Commission"). The Commission shall be composed of five members, of whom not more than three shall be members of the same political party, to be appointed by the President by and with the advice and consent of the Senate. In making such appointments the President shall give due consideration to the interests of various segments of agriculture. One of the members so appointed shall be designated as Chairman by the President.

(2) Members of the Commission shall be paid compensation at the rate of $50 per day and shall be reimbursed for necessary traveling and other expenses incurred by them in the performance of their duties as members of the Commission.

(3) The Commission is authorized to appoint and fix the compensation, without regard to the civil-service laws and the Classification Act of 1949, as amended, of an executive director and such chemists, engineers, agriculturists, attorneys, and other assistants as it may deem necessary. The Secretary of Agriculture is authorized to provide the Commission with necessary office space, and may detail, on a reimbursable basis, any personnel of the Department of Agriculture to assist the Commission in carrying out its work.

(4) Upon request of the Commission, any other department or agency of the Government having information or data needed by the Commission in carrying out its duties under this section, shall make such information or data available to the Commission for such purposes. The Commission shall take such steps as may be necessary to protect against unauthorized disclosure any such information or data which may be classified for security purposes.

(5) Service of an individual as a member of the Commission or employment of an individual by the Commission in a technical or professional field, on a part-time or full-time basis, shall not be considered as service or employment bringing such individual within the provisions of section 281, 283, 284, 434 or 1914 of title 18 of the United States Code, or section 190 of the Revised Statutes (5 U. S. C. 99).

(b) It shall be the duty of the Commission to prepare and present to the Congress, not later than June 15, 1957, the necessary recommendations which in its opinion will bring about the greatest practical use for industrial purposes of agricultural products not needed for human or animal consumption, including, but not limited to, use in the manufacture of rubber, industrial alcohol, motor fuels, plastics, and other products.

(c) There is hereby authorized to be appropriated such sum, not to exceed $150,000, as may be necessary to enable the Commission to carry out its functions.

(d) Upon submission of the recommendations referred to in subsection (b), the Commission shall cease to exist. (7 U. S. C. 1858)

DONATION TO PENAL AND CORRECTIONAL INSTITUTIONS

SEC. 210. Notwithstanding any other limitations as to the disposal of surplus commodities acquired through price support operations, the Commodity Credit Corporation is authorized on such terms and under such regulations as the Secretary of Agriculture may deem in the public interest, and upon application, to donate food commodities acquired through price support operations to Federal penal and correctional institutions, and to State correctional institutions for minors, other than those in which food service is provided for inmates on a fee, contract, or concession basis.[3] (7 U. S. C. 1859)

FEDERAL IRRIGATION. DRAINAGE, AND FLOOD-CONTROL PROJECTS

SEC. 211. (a) For a period of three years from the date of enactment of this Act, no agricultural commodity determined by the Secretary of Agriculture in accordance with subsection (c) to be in surplus supply shall receive any crop loans or Federal farm payments or benefits if grown on any newly irrigated or drained lands within any Federal irrigation or drainage project hereafter authorized unless such lands were used for the production of such commodity prior to the enactment of this Act.

(b) The Secretary of the Interior and the Secretary of Agriculture shall cause to be included, in all irrigation, drainage, or flood-control contracts entered into with respect to Federal irrigation, drainage, or flood-control projects hereafter authorized, such provisions as they may deem necessary to provide for the enforcement of the provisions of this section. For a period of three years from the date of enactment of this Act surplus crops grown on lands reclaimed by flood-control projects hereafter authorized and the lands so reclaimed shall be ineligible for any benefits under the soil-bank provisions of this Act and under price support legislation.

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[3] See also Pub. L. 85–683 (p. 136) as to flour and cornmeal donations.

(c) On or before October 1 of each year, the Secretary of Agriculture shall determine and proclaim the agricultural commodities the supplies of which are in excess of estimated requirements for domestic consumption and export plus adequate reserves for emergencies. The commodities so proclaimed shall be considered to be in surplus supply for the purposes of this section during the succeeding crop year.

(d) For the purposes of this section the term "Federal irrigation or drainage project" means any irrigation or drainage project subject to the Federal reclamation laws (Act of June 17, 1902, 32 Stat. 388, and Acts amendatory thereof or supplementary thereto) in effect at the date of the adoption of this amendment and any irrigation or drainage project subject to the laws relating to irrigation and drainage administered by the Department of Agriculture or the Secretary of Agriculture. (7 U. S. C. 1860)

SEC. 212. [This section amended section 416 of the Agricultural Act of 1949.]

TITLE III—MARKETING QUOTAS AND ACREAGE ALLOTMENTS

[This title contains amendments to the Agricultural Adjustment Act of 1938, which are incorporated in that act as contained in this compilation.]

TITLE IV—FORESTRY PROVISIONS

[This title contains provisions relating to assistance to states for tree planting and reforestation.]

TITLE V—CERTIFICATE PROGRAM FOR RICE

[This title added subtitle D—Rice Certificates to title III of the Agricultural Adjustment Act of 1938.]

TITLE VI—MISCELLANEOUS

[This title contains amendments to the Agricultural Act of 1949 and the Agricultural Adjustment Act of 1938, which are incorporated in those acts as contained in the compilation.

GENERAL FISCAL STATUTES

ACT OF MARCH 8, 1938,[1] AS AMENDED

AN ACT

To maintain unimpaired the capital of the Commodity Credit Corporation at $100,000,000, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That as of the 30th of June in each year and as soon as possible thereafter, beginning with June 30, 1945, an appraisal of all of the assets and liabilities of the Commodity Credit Corporation for the purpose of determining the net worth of the Commodity Credit Corporation shall be made by the Secretary of the Treasury. The value of assets shall be determined on the basis of the cost of such assets to the Commodity Credit Corporation,[2] and a report of any such appraisal shall be submitted to the President as soon as possible after it has been made.[3] In the event that any such appraisal shall establish that the net worth of the Commodity Credit Corporation is less than $100,000,000, the Secretary of the Treasury, on behalf of the United States, shall restore the amount of such capital impairment by a contribution to the Commodity Credit Corporation in the amount of such impairment. To enable the Secretary of the Treasury to make such payment to the Commodity Credit Corporation, there is hereby authorized to be appropriated annually, commencing with the fiscal year 1938, out of any money in the Treasury not otherwise appropriated, an amount equal to any capital impairment found to exist by virtue of any appraisal as provided herein. Such capital impairment shall be restored with appropriated funds as provided herein rather than through the cancellation of notes.[4] (15 U. S. C. 713a–1)[5]

EXCESS NET WORTH

SEC. 2. In the event that any appraisal pursuant to section 1 of this Act shall establish that the net worth of the Commodity Credit Corporation is in excess of $100,000,000, such excess shall as soon as practicable after such appraisal, be deposited in the Treasury by the Commodity Credit Corporation and shall be credited to miscellaneous receipts. The Secretary of the Treasury is directed, as soon as practicable, to use any amount so deposited to retire an equivalent

[1] 52 Stat. 107.
[2] The clause "or insofar as practicable, the average market price of such assets during the last month of the fiscal year covered by the appraisal, whichever is the lower," was deleted by the Act of March 20, 1954, 68 Stat. 30.
[3] The preceding provisions of this section were substituted for the original provisions by the Act of April 12, 1945, 59 Stat. 50, 51.
[4] This sentence was added by the Act of March 20, 1954.
[5] A number of appropriations from and payments to the Treasury have been made pursuant to this and the following section.

amount of the public debt, which amount shall be in addition to any other amount required to be used for such purpose. (15 U. S. C. 713a–2)

SEC. 3. [This section provided for the transfer of stock of the Delaware corporation to the United States.]

BORROWING POWER

SEC. 4. With the approval of the Secretary of the Treasury, the Commodity Credit Corporation is authorized to issue and have outstanding at any one time, bonds, notes, debentures, and other similar obligations in an aggregate amount not exceeding $14,500,000,000.[6] Such obligations shall be in such forms and denominations, shall have such maturities, shall bear such rates of interest, shall be subject to such terms and conditions, and shall be issued in such manner and sold at such prices as may be prescribed by the Commodity Credit Corporation, with the approval of the Secretary of the Treasury. Such obligations shall be fully and unconditionally guaranteed both as to interest and principal by the United States, and such guaranty shall be expressed on the face thereof, and such obligations shall be lawful investments and may be accepted as security for all fiduciary, trust, and public funds the investment or deposit of which shall be under the authority or control of the United States or any officer or officers thereof. In the event that the Commodity Credit Corporation shall be unable to pay upon demand, when due, the principal of, or interest on, such obligations, the Secretary of the Treasury shall pay to the holder the amount thereof which is hereby authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, and thereupon to the extent of the amount so paid the Secretary of the Treasury shall succeed to all the rights of the holders of such obligations. The Secretary of the Treasury, in his discretion, is authorized to purchase any obligations of the Commodity Credit Corporation issued hereunder, and for such purpose the Secretary of the Treasury is authorized to use as a public-debt transaction the proceeds from the sale of any securities hereafter issued under the Second Liberty Bond Act, as amended, and the purposes for which securities may be issued under such Act, as amended, are extended to include any purchases of the Commodity Credit Corporation's obligations hereunder. The Secretary of the Treasury may at any time sell any of the obligations of the Commodity Credit Corporation acquired by him under this section. All redemptions, purchases, and sales by the Secretary of the Treasury of the obligations of the Commodity Credit Corporation shall be treated as public-debt transactions of the United States. No such obligations shall be issued in excess of the assets of the Commodity Credit Corporation, including the assets to be obtained from the proceeds of such obligations, but a failure to comply with this provision shall not invalidate the obligations or the guaranty of the same: *Provided*, That this sentence shall not limit the authority of the Corporation to issue obligations for the purpose of carrying

6 This amount has been increased a number of times and was increased from $12,000,000,000 by the Act of August 1, 1956, 70 Stat. 783. See also sec. 4 (i) of the Commodity Credit Corporation Charter Act (p. 113) and the Government Corporation Control Act (31 U. S. C. 841).

out its annual budget programs submitted to and approved by the Congress pursuant to the Government Corporation Control Act (31 U. S. C., 1946 edition, sec. 841).[7] The Commodity Credit Corporation shall have power to purchase such obligations in the open market at any time and at any price. (15 U. S. C. 713a–4)

TAXATION

SEC. 5. Bonds, notes, debentures, and other similar obligations issued by the Commodity Credit Corporation under the provisions of this Act shall be deemed and held to be instrumentalities of the Government of the United States, and as such they and the income derived therefrom shall be exempt from Federal, State, municipal, and local taxation (except surtaxes, estate, inheritance, and gift taxes). The Commodity Credit Corporation, including its franchise, its capital, reserves, and surplus, and its income shall be exempt from all taxation now or hereafter imposed by the United States, by any Territory, dependency, or possession thereof, or by any State, county, municipality, or local taxing authority; except that any real property of the Commodity Credit Corporation shall be subject to State, Territorial, county, municipal, or local taxation to the same extent according to its value as other real property is taxed. (15 U. S. C. 713a–5)[8]

FEDERAL RESERVE BANKS AS FISCAL AGENTS

Act of July 16, 1943—Sec. 3. The Federal Reserve Banks are hereby authorized to act as depositaries, custodians, and fiscal agents for the Commodity Credit Corporation. (57 Stat. 566; 12 U. S. C. 395)

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[7] Proviso added by sec. 410 of the Agricultural Act of 1949.

[8] See Act of February 19, 1941, 55 Stat. 7, 9, as amended March 28, 1942, 56 Stat. 189, 190, 31 U. S. C., sec. 742a, abolishing tax exemption for income from obligations issued or guaranteed by the United States or any agency or instrumentality thereof.

LOANS AND ADVANCES TO DEPARTMENTAL AGENCIES

CROP INSURANCE AND CONSERVATION MATERIALS

The Agricultural Adjustment Act of 1938—Sec. 391 (c) [This section (p. 92) contains authority for loans by Commodity Credit Corporation to the Secretary of Agriculture during each fiscal year of such sums, not to exceed $50,000,000, as he estimates will be required to make crop insurance premium advances and to make advances for the purchase of conservation materials from January 1 to June 30 of each year, with repayment (plus interest) to be made from appropriated funds.]

COST OF CLASSING OR GRADING

Department of Agriculture Appropriation Act, 1950—* * * On and after June 29, 1949, appropriations available for classing or grading any agricultural commodity without charge to the producers thereof may be reimbursed from nonadministrative funds of the Commodity Credit Corporation for the cost of classing or grading any such commodity for producers who obtain Commodity Credit Corporation price support. (June 29, 1949, 63 Stat. 324, 344; 7 U. S .C. 440.)

Department of Agriculture Appropriation Act, 1952—* * * Hereafter there may be transferred to appropriations available for classing or grading any agricultural commodity without charge to the producers thereof such sums from nonadministrative funds of the Commodity Credit Corporation as may be necessary in addition to other funds available for these purposes, such transfers to be reimbursed from subsequent appropriations therefor. (Aug. 31, 1951, 65 Stat. 225, 239; 7 U. S. C. 414a.)

BRUCELLOSIS ERADICATION

Agricultural Act of 1954—Sec. 204, as amended * * *

(e) As a means of stabilizing the dairy industry and further suppressing and eradicating brucellosis in cattle, the Secretary is authorized to transfer not to exceed $17,000.000 for the fiscal year ending June 30, 1956, and $20,000,000 for each of the fiscal years 1957 and 1958, from funds available to the Commodity Credit Corporation to the appropriation item "Plant and Animal Disease and Pest Control" in the Department of Agriculture Appropriation Act for such fiscal year for the purpose of accelerating the brucellosis eradication program, for the purpose of increasing to not to exceed $50 per head of cattle the amount of the indemnities paid by the Federal Government for cattle destroyed because of brucellosis in connection with cooperative control and eradication programs for such disease in

cattle entered into by the Secretary under the authority of the Act of May 29, 1884, as amended, for the purpose of increasing the number of such indemnities, and for the purpose of defraying any additional administrative expenses in connection therewith. There are hereby authorized to be appropriated such sums as may be necessary to reimburse the Commodity Credit Corporation for expenditures pursuant to this section.[1]

DISEASES OF ANIMALS AND POULTRY

Department of Agriculture and Farm Credit Administration Appropriation Act, 1959—* * *

Eradication activities: For expenses necessary in the arrest and eradication of foot-and-mouth disease, rinderpest, contagious pleuro-pneumonia, or other contagious or infectious diseases of animals, or European fowl pest and similar diseases in poultry, and for foot-and-mouth disease and rinderpest programs undertaken pursuant to the provisions of the Act of February 28, 1947, and the Act of May 29, 1884, as amended (7 U. S. C. 391; 21 U. S. C. 111–122), including expenses in accordance with section 2 of said Act of February 28, 1947, the Secretary may transfer from other appropriations or funds available to the bureaus, corporations, or agencies of the Department such sums as he may deem necessary, but not to exceed $1,000,000 for eradication of vesicular exanthema of swine, to be available only in an emergency which threatens the livestock or poultry industry of the country, and any unexpended balances of funds transferred under this head in the next preceding fiscal year shall be merged with such transferred amounts: *Provided*, That this appropriation shall be subject to applicable provisions contained in the item "Salaries and expenses, Agricultural Research Service". (June 13, 1958, P. L. 85–459, 72 Stat. 188) (See 21 U. S. C. 129)

[1] The provisions of this section were substituted for the previous provisions by the act of April 2, 1956, 70 Stat. 86.

MISCELLANEOUS COMMODITY CREDIT CORPORATION STATUTES

REIMBURSEMENT BY OTHER AGENCIES

Act of July 16, 1943—Sec. 4. Full reimbursement shall be made to the Commodity Credit Corporation for services performed, losses sustained, operating costs incurred, or commodities purchased or delivered to or on behalf of the Lend-Lease Administration, the Army or Navy, the Board of Economic Warfare, the Reconstruction Finance Corporation, or any other Government agency, from the appropriate funds of these agencies. (57 Stat. 566; 15 U. S. C. 713a–9.)

TRANSFER OF STOCKPILE COTTON

Public Law 85-96

July 10, 1957

JOINT RESOLUTION

Relating to the stockpile of extra long staple cotton under the Strategic and Critical Materials Stockpiling Act.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That notwithstanding any other provision of law, fifty thousand bales of domestically grown extra long staple cotton in the stockpile (including any cotton which does not meet current stockpile specifications) established pursuant to the Strategic and Critical Materials Stockpiling Act, as amended (50 U. S. C. 98), shall be withdrawn and transferred to the Commodity Credit Corporation for sale at not less than the prices at which the Commodity Credit Corporation may sell its stocks under the minimum pricing provision of section 407 of the Agricultural Act of 1949, as amended. Proceeds from such sale, less costs incurred by Commodity Credit Corporation, including administrative expense, as determined by the Secretary of Agriculture, shall be covered into the Treasury of the United States as miscellaneous receipts. (71 Stat. 290)

COTTON FOR COLLEGES

Agricultural Act of 1958—Sec. 505. Commodity Credit Corporation is authorized, on such terms as the Secretary of Agriculture may approve, to donate cotton acquired through its price support operations to educational institutions for use in the training of students in the processing and manufacture of cotton into textiles. (72 Stat. 996, 7 U. S. C. 1431a)

DISASTER RELIEF

Act of April 6, 1949—Sec. 2. * * *

(d) The Secretary is authorized in connection with any major disaster determined by the President to warrant assistance by the Federal Government under Public Law 875, Eighty-first Congress (42 U. S. C. 1855), as amended, to furnish to established farmers, ranchers, or stockmen feed for livestock or seeds for planting for such period or periods of time and under such terms and conditions as the Secretary may determine to be required by the nature and effect of the disaster. The Secretary may utilize the personnel, facilities, property, and funds of any agency of the United States Department of Agriculture, including Commodity Credit Corporation, for carrying out these functions and shall reimburse the agencies so utilized for the value of any commodities furnished which are not paid for by the farmers or ranchmen, and for costs and administrative expenses necessary in performing such functions. (63 Stat. 43, as amended by the Act of July 14, 1953, 67 Stat. 149; 12 U. S. C. 1148a–2)

Act of September 30, 1950—Sec. 2. As used in this Act, the following terms shall be construed as follows unless a contrary intent appears from the context:

(a) "Major disaster" means any flood, drought, fire, hurricane, earthquake, storm, or other catastrophe in any part of the United States which, in the determination of the President, is or threatens to be of sufficient severity and magnitude to warrant disaster assistance by the Federal Government to supplement the efforts and available resources of States and local governments in alleviating the damage, hardship, or suffering caused thereby, and respecting which the governor of any State (or the Board of Commissioners of the District of Columbia) in which such catastrophe may occur or threaten certifies the need for disaster assistance under this Act, and shall give assurance of expenditure of a reasonable amount of the funds of the government of such State, local governments therein, or other agencies, for the same or similar purposes with respect to such catastrophe;

(b) "United States" includes the District of Columbia, Alaska, Hawaii, Puerto Rico, and the Virgin Islands;

(c) "State" means any State in the United States, Alaska, Hawaii, Puerto Rico, and the Virgin Islands;

(d) "Governor" means the chief executive of any State;

(e) "Local government" means any county, city, village, town, district, or other political subdivision of any State, or the District of Columbia;

(f) "Federal agency" means any department, independent establishment, Government corporation, or other agency of the executive branch of the Federal Government, excepting, however, the American National Red Cross. (42 U. S. C. 1855a)

Sec. 3. In any major disaster, Federal agencies are hereby authorized when directed by the President to provide assistance (a) by utilizing or lending with or without compensation therefor, to States and local governments their equipment, supplies, facilities, person-

nel, and other resources, other than the extension of credit under the authority of any Act; * * * (c) by donating or lending equipment and supplies, determined under then existing law to be surplus to the needs and responsibilities of the Federal Government, to States for use or distribution by them for the purposes of the Act including the restoration of public facilities damaged or destroyed in such major disaster and essential rehabilitation of individuals in need as the result of such major disaster; * * * The authority conferred by this Act, and any funds provided hereunder shall be supplementary to, and not in substitution for, nor in limitation of, any other authority conferred or funds provided under any other law. Any funds received by Federal agencies as reimbursement for services or supplies furnished under the authority of this section shall be deposited to the credit of the appropriation or appropriations currently available for such services or supplies. The Federal Government shall not be liable for any claim based upon the exercise or performance or the failure to exercise or perform a discretionary function or duty on the part of a Federal agency or an employee of the Government in carrying out the provisions of this section. (64 Stat. 1109; as amended by the Act of July 17, 1953, 67 Stat. 180; 42 U. S. C. 1855b)

Public Law 85–312

September 7, 1957

AN ACT

To authorize Commodity Credit Corporation to grant relief with respect to claims arising out of deliveries of eligible surplus feed grains on ineligible dates in connection with purchase orders under its emergency feed program.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Commodity Credit Corporation, under such regulations as may be approved by the Secretary of Agriculture, is hereby authorized to grant relief to farmers and dealers in connection with claims arising out of early and late deliveries under purchase orders for drought relief feed issued under the 1954, 1955, and 1956 emergency feed programs, by recognizing as valid those purchases and deliveries of designated surplus feed grains and approved mixed feeds, which (a) were actually purchased by the farmer from the dealer on or after the date the Secretary declared the county, where the purchase order was issued, to be eligible for assistance under the emergency feed program, and (b) are found to have been physically delivered to the farmer not later than six months from the expiration date of the purchase order issued to the farmer. (71 Stat. 632, 12 U. S. C. 1148a–2)

SALE TO FOREIGN GOVERNMENTS

Act of August 11, 1939—Notwithstanding any other provision of law, the Commodity Credit Corporation, with the approval of the President, is authorized to sell surplus agricultural commodities, acquired by such Corporation through its loan operations, to foreign governments on the condition that, except for rotation to prevent

deterioration, such commodities shall be held in reserve by such governments for a period of not less than five years from the date of acquisition, and shall not be disposed of unless a war or war emergency results in a serious interruption of normal supplies of such commodities: *Provided*, That under this joint resolution no concession below the prevailing world market price for the unrestricted use of such commodities, as determined by the Secretary of Agriculture, shall be granted, in consideration of the obligation assumed by such governments to hold such commodities in reserve as required hereinbefore, in excess of a maximum amount equal to the average carrying charges, as estimated by the Secretary of Agriculture, that would be incurred if such commodities should be held for an additional eighteen months' period by the Commodity Credit Corporation. In determining specific cotton to be sold under this Act, the determination shall be made by sampling and selection at the place where the cotton is stored on the date of signing any sales agreement or contract under this Act, and no cotton shall be sold under any such sales agreement or contract which, after such date, is transported to any other place and there sampled and selected: *Provided further*, That in case of a sale settlement must be made within sixty days after delivery and not more than five hundred thousand bales of cotton shall be sold upon the terms and conditions provided in this joint resolution. (Pub. Res. 52, 76th Cong., 53 Stat. 1418; 15 U. S. C. 713a–6.)

GRAIN FOR MIGRATORY WATERFOWL

ACT OF JULY 3, 1956[1]

AN ACT

To authorize the Secretary of the Interior to cooperate with Federal and non-Federal agencies in the prevention of waterfowl depredations, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, for the purpose of preventing crop damage by migratory waterfowl, the Commodity Credit Corporation shall make available to the Secretary of the Interior such wheat, corn, or other grains, acquired through price support operations and certified by the Commodity Credit Corporation to be available for the purposes of this Act or in such condition through spoilage or deterioration as not to be desirable for human consumption, as the Secretary of the Interior shall requisition pursuant to section 2 hereof. With respect to any grain thus made available, the Commodity Credit Corporation may pay packaging, transporting, handling, and other charges up to the time of delivery to one or more designated locations in each State. (7 U. S. C. 442)

SEC. 2. Upon a finding by the Secretary of the Interior that any area in the United States is threatened with damage to farmers' crops by migratory waterfowl, whether or not during the open season for such migratory waterfowl, the Secretary of the Interior is hereby authorized and directed to requisition from the Commodity Credit Corporation and to make available to Federal, State, or local governmental bodies or officials, or to private organizations or persons, such grain acquired by the Commodity Credit Corporation through price-support operations in such quantities and subject to such regulations as the Secretary determines will most effectively lure migratory waterfowl away from crop depredations and at the same time not expose such migratory waterfowl to shooting over areas to which the waterfowl have been lured by such feeding programs. (7 U. S. C. 443)

SEC. 3. With respect to all grain made available pursuant to section 2, the Commodity Credit Corporation shall be reimbursed by the Secretary of the Interior for its expenses in packaging and transporting such grain for purposes of this Act. (7 U. S. C. 444)

SEC. 4. There are hereby authorized to be appropriated such sums as may be necessary to reimburse the Commodity Credit Corporation for its investment in the grain transferred pursuant to this Act. (7 U. S. C. 445)

SEC. 5. No grain shall be made available by the Commodity Credit Corporation under this Act after the expiration of three years following its enactment. (7 U. S. C. 446)

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[1] 70 Stat. 492.

ADMINISTRATIVE EXPENSE LIMITATION

[See the Commodity Credit Corporation item in the Department of Agriculture and Farm Credit Administration Appropriation Act, 1959, in Part VIII hereof, and the similar items in previous appropriation acts. Section 104 of the Government Corporation Control Act (approved Dec. 6, 1945, 59 Stat. 597; 31 U. S. C. 841) provides for enactment of necessary appropriations making available corporate funds of each wholly owned Government corporation for administrative expenses or limiting the use thereof.]

EXEMPTION FROM FEDERAL PROPERTY AND ADMINISTRATIVE SERVICES ACT

Act of June 30, 1949, as amended—Sec. 602. * * * Nothing in this Act shall impair or affect any authority of—* * * (2) any executive agency with respect to any phase (including, but not limited to, procurement, storage, transportation, processing, and disposal) of any program conducted for purposes of resale, price support, grants to farmers, stabilization, transfer to foreign governments, or foreign aid, relief, or rehabilitation: *Provided*, That the agency carrying out such program shall, to the maximum extent practicable, consistent with the fulfillment of the purposes of the program and the effective and efficient conduct of its business, coordinate its operations with the requirements of said chapters and the policies and regulations prescribed pursuant thereto; * * *. (June 30, 1949, 63 Stat. 377, 401; Sept. 5, 1950, 64 Stat. 578, 583; 40 U. S. C. 474)

REIMBURSEMENT OF PROCUREMENT COSTS

Department of Agriculture Organic Act of 1944—Sec. 402. Applicable appropriations available to the War Food Administration[1] current at the time services are rendered or payment therefor is received may be reimbursed by nongovernmental agencies or foreign governments (by advance credits or reimbursements) for the actual or estimated costs, as determined by the War Food Administration, incident to procuring agricultural commodities for such nongovernmental agencies or foreign governments. (Sept. 21, 1944, 58 Stat. 734, 738; 5 U. S. C. 569)

TREATMENT OF COMMODITY CREDIT LOANS FOR INCOME TAX PURPOSES

INTERNAL REVENUE CODE OF 1954 [2]

SEC. 77. COMMODITY CREDIT LOANS.

(a) Election To Include Loans in Income.—Amounts received as loans from the Commodity Credit Corporation shall, at the election of the taxpayer, be considered as income and shall be included in gross income for the taxable year in which received.

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[1] The War Food Administration was terminated by Executive Order No. 9577, and its functions transferred to the Secretary of Agriculture (E. O. 9577, June 29, 1945, 10 F. R. 8087).

[2] 26 U. S. C. 77, 1016. These provisions of the Internal Revenue Code are derived from the Act of June 29, 1939, 53 Stat. 862, 879, and the Act of October 21, 1942, 56 Stat. 798, 848. These Acts also contained provisions as to retroactive application of these provisions. See 26 U. S. C. 123 note.

(b) Effect of Election on Adjustments for Subsequent Years.—If a taxpayer exercises the election provided for in subsection (a) for any taxable year, then the method of computing income so adopted shall be adhered to with respect to all subsequent taxable years unless with the approval of the Secretary or his delegate a change to a different method is authorized.

SEC. 1016. ADJUSTMENTS TO BASIS.

(a) General Rule.—Proper adjustment in respect of the property shall in all cases be made—

* * * * * * *

(8) in the case of property pledged to the Commodity Credit Corporation, to the extent of the amount received as a loan from the Commodity Credit Corporation and treated by the taxpayer as income for the year in which received pursuant to section 77, and to the extent of any deficiency on such loan with respect to which the taxpayer has been relieved from liability;

INSURANCE OF COTTON AND RECONCENTRATION OF COTTON

[See section 383 of the Agricultural Adjustment Act of 1938 and Pub. L. 660, Seventy-fifth Congress, p. 89.]

STIMULATION OF FOREIGN PRODUCTION

Taft Anti-Inflation Law—Sec. 7. Notwithstanding any other provision of law, in order to alleviate and prevent shortages in foods, agricultural commodities, and products thereof, Commodity Credit Corporation is authorized to carry out projects to stimulate and increase the production of foods, agricultural commodities, and products thereof, in non-European foreign countries. Such projects may include procurement, the making of advances and price guaranties, the furnishing of technical information and assistance, the furnishing of seed, fertilizer, machinery, equipment, and other materials, and such other actions as are necessary or incident to the carrying out of such projects: *Provided*, That any such program is first submitted to Congress by the Secretary of Agriculture, and is not disapproved by concurrent resolution of Congress within sixty days thereafter. (Dec. 30, 1947, 61 Stat. 945, 947; 50 U. S. C. App. 1917)

OTHER PRINCIPAL STATUTES APPLICABLE TO COMMODITY CREDIT CORPORATION

Government Corporation Control Act (Dec. 6, 1945, 59 Stat. 597; 31 U. S. C. 841).

Sections 222 and 1026 of the Criminal Code (June 25, 1948, 62 Stat. 683, 696, 755; 18 U. S. C. 222, 1026) providing penalties for acceptance of fees in connection with cancellation of farm indebtedness.

Section 206 of the Technical Changes Act of 1953 (August 15, 1953, 67 Stat. 615, 620; 26 U. S. C. 124B) providing for amortization deductions for grain storage facilities. [Regulations were issued under this section by the Commissioner of Internal Revenue on Nov.

15, 1954, and were published in the Federal Register on Nov. 19, 1954. 19 F. R. 7453.]

Act of June 11, 1947, as amended (61 Stat. 308; 71 Stat. 464; 31 U. S. C. 132), requiring withdrawal of the amount of all checks, which have not been paid prior to the close of the fiscal year next following the fiscal year in which issued, from the account of designated depositories and deposit of the amount with the Treasurer of the United States for credit to a consolidated account.

Section 9 (c) of the Act of August 2, 1946 (60 Stat. 806, 809), providing that the bid procedure set out in section 3709, Revised Statutes, as amended (41 U. S. C. 5), shall apply only to the administrative transactions of wholly-owned government corporations.

Independent Offices Appropriation Act, 1950 (Aug. 24, 1949, 63 Stat. 631, 662; 31 U. S. C. 870), authorizing corporations subject to the Government Corporation Control Act to consolidate into one or more accounts for banking and checking purposes all cash, including amounts appropriated, from whatever source derived.

Title II—General Provisions of the General Government Matters Appropriation Act, 1959. (Pub. L. 85–468, 72 Stat. 220, 5 U. S. C. 75a–1)

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SUBPART C—EXPORT AND SURPLUS REMOVAL

[See also the following statutory provisions:

	Page
Section 4 (h) of the Commodity Credit Corporation Charter Act (barter of agricultural commodities for strategic and critical materials produced abroad)	111
Section 407 of the Agricultural Act of 1949 (making farm commodities available to relieve distress)	131
Section 416 of the Agricultural Act of 1949 (disposition of surplus commodities)	135
Title I of the Agricultural Act of 1954 (set aside of agricultural commodities)	138
Title VI of the Agricultural Act of 1954 (acquiring information on foreign demand for United States agricultural commodities)	141
Title II of the Agricultural Act of 1956 (disposition of stocks of agricultural commodities)]	145

AGRICULTURAL TRADE DEVELOPMENT AND ASSISTANCE ACT OF 1954,[1] AS AMENDED

Public Law 480—83d Congress

AN ACT

To increase the consumption of United States agricultural commodities in foreign countries, to improve the foreign relations of the United States, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Agricultural Trade Development and Assistance Act of 1954".

SEC. 2. It is hereby declared to be the policy of Congress to expand international trade among the United States and friendly nations, to facilitate the convertibility of currency, to promote the economic stability of American agriculture and the national welfare,

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[1] Approved July 10, 1954, 68 Stat. 454. See also sec. 402 of the Mutual Security Act of 1954, as amended (22 U. S. C. 1922), which provides:

"SEC. 402. EARMARKING OF FUNDS.—Of the funds authorized to be made available in the fiscal year 1959 pursuant to this Act (other than funds made available pursuant to title II), not less than $175,000,000 shall be used to finance the export and sale for foreign currencies of surplus agricultural commodities or products thereof produced in the United States, in addition to surplus agricultural commodities or products transferred pursuant to the Agricultural Trade Development and Assistance Act of 1954, and in accordance with the standards as to pricing and the use of private trade channels expressed in section 101 of said Act. Foreign currency proceeds accruing from such sales shall be used for the purposes of this Act and with particular emphasis on the purposes of section 104 of the Agricultural Trade Development and Assistance Act of 1954 which are in harmony with the purposes of this Act. Notwithstanding section 1415 of the Supplemental Appropriation Act, 1953, or any other provision of law, the President may use or enter into agreements with friendly nations or organizations of nations to use for such purposes the foreign currencies which accrue to the United States under this section."

to make maximum efficient use of surplus agricultural commodities in furtherance of the foreign policy of the United States, and to stimulate and facilitate the expansion of foreign trade in agricultural commodities produced in the United States by providing a means whereby surplus agricultural commodities in excess of the usual marketings of such commodities may be sold through private trade channels, and foreign currencies accepted in payment therefor. It is further the policy to use foreign currencies which accrue to the United States under this Act to expand international trade, to encourage economic development, to purchase strategic materials, to pay United States obligations abroad, to promote collective strength, and to foster in other ways the foreign policy of the United States. (7 U. S. C. 1691)

TITLE I—SALES FOR FOREIGN CURRENCY[2]

SEC. 101. In furtherance of this policy, the President is authorized to negotiate and carry out agreements with friendly nations or organizations of friendly nations to provide for the sale of surplus agricultural commodities for foreign currencies. In negotiating such agreements the President shall—

(a) take reasonable precautions to safeguard usual marketings of the United States and to assure that sales under this Act will not unduly disrupt world prices of agricultural commodities or normal patterns of commercial trade with friendly countries;[3]

(b) take appropriate steps to assure that private trade channels are used to the maximum extent practicable both with respect to sales from privately owned stocks and from stocks owned by the Commodity Credit Corporation;

(c) give special consideration to utilizing the authority and funds provided by this Act, in order to develop and expand continuous market demand abroad for agricultural commodities, with appropriate emphasis on underdeveloped and new market areas;

(d) seek and secure commitments from participating countries that will prevent resale or transshipment to other countries, or use for other than domestic purposes, of surplus agricultural commodities purchased under this Act, without specific approval of the President; and

(e) afford any friendly nation the maximum opportunity to purchase surplus agricultural commodities from the United States, taking into consideration the opportunities to achieve the declared policy of this Act and to make effective use of the foreign currencies received to carry out the purposes of this Act. (7 U. S. C. 1701)

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[2] Sec. 3 of the Act of August 3, 1956, 70 Stat. 988, provides that sales of fresh fruit and the products thereof under Title I shall be exempt from the requirements of the cargo preference laws.

[3] Phrase beginning with "or" added by Pub. L. 85-931, 72 Stat. 1790, approved September 6, 1958.

SEC. 102.[4] (a) For the purpose of carrying out agreements concluded by the President hereunder, the Commodity Credit Corporation, in accordance with regulations issued by the President pursuant to subsection (b) of this section, (1) shall make available for sale hereunder to domestic exporters surplus agricultural commodities heretofore or hereafter acquired by the Corporation in the administration of its price-support operations, and (2) shall make funds available to finance the sale and exportation of surplus agricultural commodities, whether from private stocks or from stocks of the Commodity Credit Corporation. In supplying such commodities to exporters under this subsection the Commodity Credit Corporation shall not be subject to the sales price restrictions in section 407 of the Agricultural Act of 1949, as amended. The commodity set-aside established for any commodity under section 101 of the Agricultural Act of 1954 (68 Stat. 897) shall be reduced by a quantity equal to the quantity of such commodity financed hereunder which is exported from private stocks. (7 U. S. C. 1702 (a))[5]

(b) In order to facilitate and maximize the use of private channels of trade in carrying out agreements entered into pursuant to this Act, the President may, under such regulations and subject to such safeguards as he deems appropriate, provide for the issuance of letters of commitment against funds or guaranties of funds supplied by the Commodity Credit Corporation and for this purpose accounts may be established on the books of any department, agency, or establishment of the Government, or on terms and conditions approved by the Secretary of the Treasury in banking institutions in the United States. Such letters of commitment, when issued, shall constitute obligations of the United States and moneys due or to become due thereunder shall be assignable under the Assignment of Claims Act of 1940. Expenditures of funds which have been made available through accounts so established shall be accounted for on standard documentation required for expenditures of Government funds. (7 U. S. C. 1702 (b))

SEC. 103. (a) For the purpose of making payment to the Commodity Credit Corporation to the extent the Commodity Credit Corporation is not reimbursed under section 105 for commodities disposed of and costs incurred under titles I and II of this Act, there are hereby authorized to be appropriated such sums as are equal to (1) the Corporation's investment in commodities made available for export under this title and title II of this Act, including processing, packaging, transportation, and handling costs, (2) all costs incurred by the Corporation in making funds available to finance the exporta-

[4] Sec. 8 of Pub. L. 85-931, 72 Stat. 1792, approved September 6, 1958, provides as follows:

In carrying out the provisions of the Agricultural Trade Development and Assistance Act of 1954, as amended, extra long staple cotton shall be made available for sale pursuant to the provisions of title I of the Act in the same manner as upland cotton or any other surplus agricultural commodity is made available, and products manufactured from upland or long staple cotton shall be made available for sale pursuant to the provisions of title I of the Act as long as cotton is in surplus supply, and no discriminatory or other conditions shall be imposed which will prevent or tend to interfere with their sale or availability for sale under the Act: *Provided*, That that portion of the sales price of such products which is financed as a sale for foreign currency under title I of the Act shall be limited to the estimated portion of the sales price of such products attributable to the raw cotton content of such products.

[5] Act of April 25, 1955, 69 Stat. 44, amended clause (2) by removing requirements with respect to financing of sales from privately owned stocks and added last sentence.

tion of surplus agricultural commodities pursuant to this title and, (3) all Commodity Credit Corporation funds expended for ocean freight costs authorized under title II hereof for purposes of section 416 of the Agricultural Act of 1949, as amended.[6] Any funds or other assets available to the Commodity Credit Corporation may be used in advance of such appropriation or payments, for carrying out the purposes of this Act. (7 U. S. C. 1703 (a))

(b) Agreements shall not be entered into under this title during the period beginning July 1, 1958, and ending December 31, 1959, which will call for appropriations to reimburse the Commodity Credit Corporation, pursuant to subsection (a) of this section, in amounts in excess of $2,250,000,000. plus any amount by which agreements entered into in prior fiscal years have called or will call for appropriations to reimburse the Commodity Credit Corporation in amounts less than authorized for such prior fiscal years by this Act as in effect during such fiscal years. (7 U. S. C. 1703 (b))[7]

SEC. 104.[8] Notwithstanding section 1415 of the Supplemental Appropriation Act, 1953, or any other provision of law, the President may use or enter into agreements with friendly nations or organizations of nations to use the foreign currencies which accrue under this title for one or more of the following purposes:[9]

(a) To help develop new markets for United States agricultural commodities on a mutually benefiting basis;

(b) To purchase or contract to purchase strategic and critical materials, within the applicable terms of the Strategic and Critical Materials Stockpile Act, for a supplemental United States stockpile of such materials as the President may determine from time to time under contracts, including advance payment contracts, for supply extending over periods up to ten years. All strategic and critical materials acquired under authority of this title shall be placed in the above named supplemental stockpile and may be additional to the amounts acquired under authority of the Strategic and Critical Materials Stockpile Act. Materials so acquired shall be released from the supplemental stockpile only under the provisions of section 3 of the Strategic and Critical Materials Stockpile Act;

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[6] Clause (3) added by sec. 208 (a) of Agricultural Act of 1956.

[7] As amended by Pub. L. 85 931, 72 Stat. 1790, approved September 6, 1958. This subsection had previously been amended a number of times.

[8] Pub. L. 85-128, 71 Stat. 345, approved August 13, 1957, provides that within sixty days after any agreement is entered into for the use of any foreign currencies, a full report thereon shall be made to the Senate and House of Representatives of the United States and to the Committees on Agriculture and Appropriations thereof. (7 U. S. C. 1704 (a))

[9] See also sec. 407 of the Act of September 1, 1954, as amended (5 U. S. C. 171z-1), which provides:

"In addition to family housing and community facilities otherwise authorized to be constructed or acquired by the Department of Defense, the Secretary of Defense is authorized, subject to the approval of the Director of the Bureau of the Budget, to construct, or acquire by lease or otherwise, family housing for occupancy as public quarters, and community facilities, in foreign countries through housing and community facilities projects which utilize foreign currencies to a value not to exceed $250,000,000 acquired pursuant to the provisions of the Agricultural Trade Development and Assistance Act of 1954 or through other commodity transactions of the Commodity Credit Corporation.

"The Department of Defense shall pay the Commodity Credit Corporation, from appropriations otherwise available for the payment of quarters allowances for military personnel and from appropriate allotments or rental charges for civilian personnel, amounts equal to the quarters allowances or allotments otherwise payable to or the rental charges collected from personnel occupying any housing constructed or acquired under authority of this section after deducting amounts chargeable for the maintenance and operation of such housing: *Provided*, That such payments shall not exceed the dollar equivalent of the value of the foreign currencies used for all such construction or acquisition."

(c) To procure military equipment, materials, facilities, and services for the common defense;

(d) For financing the purchase of goods or services for other friendly countries;

(e) For promoting balanced economic development and trade among nations, for which purposes not more than 25 per centum of the currencies received pursuant to each such agreement shall be available through and under the procedures established by the Export-Import Bank for loans mutually agreeable to said bank and the country with which the agreement is made to United States business firms and branches, subsidiaries, or affiliates of such firms for business development and trade expansion in such countries and for loans to domestic or foreign firms for the establishment of facilities for aiding in the utilization, distribution, or otherwise increasing the consumption of, and markets for, United States agricultural products: *Provided, however*, That no such loans shall be made for the manufacture of any products to be exported to the United States in competition with products produced in the United States or for the manufacture or production of any commodity to be marketed in competition with United States agricultural commodities or the products thereof. Foreign currencies may be accepted in repayment of such loans;[10]

(f) To pay United States obligations abroad;

(g) For loans to promote multilateral trade and economic development, made through established banking facilities of the friendly nation from which the foreign currency was obtained or in any other manner which the President may deem to be appropriate. Strategic materials, services, or foreign currencies may be accepted in payment of such loans;

(h) For the financing of international educational exchange activities under the programs authorized by section 32 (b) (2) of the Surplus Property Act of 1944, as amended (50 U. S. C. App. 1641 (b)) and for the financing in such amounts as may be specified from time to time in appropriation acts of programs for the interchange of persons under title II of the United States Information and Educational Exchange Act of 1948, as amended (22 U. S. C. 1446). In the allocation of funds as among the various purposes set forth in this section, a special effort shall be made to provide for the purposes of this subsection, including a particular effort with regard to: (1) countries where adequate funds are not available from other sources for such purposes, and (2) countries where agreements can be negotiated to establish a fund with the interest and principal available over a period of years for such purposes, such special and particular effort to include the setting aside of such amounts from sale proceeds and loan repayments under this title, not in excess of $1,000,000 a year in any one country for a period of not more than five years in advance, as may be determined by the Secretary of State to be required for the purposes of this subsection;[11]

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10 As amended by Pub. L. 85-128, 71 Stat. 345, approved August 13, 1957.

11 As amended by the Mutual Security Act of 1956, 70 Stat. 555, 564, Pub. L. 85-141, 71 Stat. 365, approved August 14, 1957, and Pub. L. 85-931, 72 Stat. 1790, approved September 6, 1958.

(i) For financing the translation, publication, and distribution of books and periodicals, including Government publications, abroad: *Provided*, That not more than $5,000,000 may be allocated for this purpose during any fiscal year;[12]

(j) For providing assistance to activities and projects authorized by section 203 of the United States Information and Educational Exchange Act of 1948, as amended (22 U. S. C. 1448), but no foreign currencies which are available under the terms of any agreement for appropriation for the general use of the United States shall be used for the purposes of this subsection (j) without appropriation therefor;[13]

(k) To collect, collate, translate, abstract, and disseminate scientific and technological information and to conduct and support scientific activities overseas including programs and projects of scientific cooperation between the United States and other countries such as coordinated research against diseases common to all of mankind or unique to individual regions of the globe, but no foreign currencies shall be used for the purposes of this subsection (k) unless specific appropriations be made therefor;[14]

(l) For the acquisition by purchase, lease, rental or otherwise of sites and buildings and grounds abroad, for United States Government use including offices, residence quarters, community and other facilities, and for construction, repair, alteration and furnishing of such buildings and facilities: *Provided*, That foreign currencies shall be available for the purposes of this subsection (in addition to funds otherwise made available for such purposes) in such amounts as may be specified from time to time in appropriation acts;

(m) For financing in such amounts as may be specified from time to time in appropriation acts (A) trade fair participation and related activities authorized by section 3 of the International Cultural Exchange and Trade Fair Participation Act of 1956 (22 U. S. C. 1992), and (B) agricultural and horticultural fair participation and related activities;

(n) For financing under the direction of the Librarian of Congress, in consultation with the National Science Foundation and other interested agencies, in such amounts as may be specified from time to time in appropriation acts, (1) programs outside the United States for the analysis and evaluation of foreign books, periodicals, and other materials to determine whether they would provide information of technical or scientific significance in the United States and whether such books, periodicals, and other materials are of cultural or educational significance; (2) the registry, indexing, binding, reproduction, cataloging, abstracting, translating, and dissemination of books, periodicals, and related materials determined to have such significance; and (3) the acquisition of such books, periodicals,

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[12] Subsec. (i) added by the Mutual Security Act of 1956, 70 Stat. 555, 565.

[13] Subsec. (j) added by the Act of August 3, 1956, 70 Stat. 988.

[14] Subsec. (k) added by Pub. L. 85-477, 72 Stat. 261, 275, approved June 30, 1958. The Supplemental Appropriation Act, 1959, appropriates $5,100,000 to remain available until expended, to the President for the purchase of foreign currencies, pursuant to subsec. 104 (k), for disseminating scientific and technological information and supporting scientific activities overseas. Pub. L. 85-766, 72 Stat. 864, 871, approved August 27, 1958.

and other materials and the deposit thereof in libraries and research centers in the United States specializing in the areas to which they relate;

(o) For providing assistance, in such amounts as may be specified from time to time in appropriation acts, by grant or otherwise, in the expansion or operation in foreign countries of established schools, colleges, or universities founded or sponsored by citizens of the United States, for the purpose of enabling such educational institutions to carry on programs of vocational, professional, scientific, technological, or general education; and in the supporting of workshops in American studies or American educational techniques, and supporting chairs in American studies:[15]

Provided, however, That section 1415 of the Supplemental Appropriation Act, 1953,[16] shall apply to all foreign currencies used for grants under subsections (d) and (e) and for payment of United States obligations involving grants under subsection (f) and to not less than 10 per centum of the foreign currencies which accrue under this title: *Provided, however*, That the President is authorized to waive such applicability of section 1415 in any case where he determines that it would be inappropriate or inconsistent with the purposes of this title. (7 U. S. C. 1704)

SEC. 105. Foreign currencies received pursuant to this title shall be deposited in a special account to the credit of the United States and shall be used only pursuant to section 104 of this title, and any department or agency of the government using any of such currencies for a purpose for which funds have been appropriated shall reimburse the Commodity Credit Corporation in an amount equivalent to the dollar value of the currencies used. (7 U. S. C. 1705)

SEC. 106. As used in this Act, "surplus agricultural commodity" shall mean any agricultural commodity or product thereof, class, kind, type, or other specification thereof, produced in the United States, either privately or publicly owned, which is or may be reasonably expected to be in excess of domestic requirements, adequate carryover, and anticipated exports for dollars, as determined by the Secretary of Agriculture. The Secretary of Agriculture is also authorized to determine the nations with whom agreements shall be negotiated, and to determine the commodities and quantities thereof which may be included in the negotiations with each country after advising with other agencies of Government affected and within broad policies laid down by the President for implementing this Act.[17] (17 U. S. C. 1706)

SEC. 107. As used in this Act, "friendly nation" means any country other than (1) the U. S. S. R., or (2) any nation or area dominated or controlled by the foreign government or foreign organization controlling the world Communist movement. (7 U. S. C. 1707)

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15 Subsections (l), (m), (n), and (o) added by Pub. L. 85-931, 72 Stat. 1791, approved September 6, 1958.

16 Section 1415 provides that "Foreign credits owed to or owned by the United States Treasury will not be available for expenditure by agencies of the United States after June 30, 1953, except as may be provided for annually in appropriation Acts and provisions for the utilization of such credits for purposes authorized by law are hereby authorized to be included in general appropriation Acts."

17 Last sentence added by the Act of August 12, 1955, 69 Stat. 721.

SEC. 108. The President shall make a report to Congress with respect to the activities carried on under this Act at least once each six months and at such other times as may be appropriate and such reports shall include the dollar value, at the exchange rates in effect at the time of the sale, of the foreign currency for which commodities exported pursuant to section 102 (a) hereof are sold. (7 U. S. C. 1708)

SEC. 109. No transactions shall be undertaken under authority of this title after December 31, 1959,[18] except as required pursuant to agreements theretofore entered into pursuant to this title. (7 U. S. C. 1709)

TITLE II—FAMINE RELIEF AND OTHER ASSISTANCE[19]

SEC. 201. In order to enable the President to furnish emergency assistance on behalf of the people of the United States to friendly peoples in meeting famine or other urgent or extraordinary[20] relief requirements, the Commodity Credit Corporation shall make available to the President out of its stocks such surplus agricultural commodities (as defined in section 106 of title I)[21] as he may request, for transfer (1) to any nation friendly to the United States in order to meet famine or other urgent or extraordinary[20] relief requirements of such nation, and (2) to friendly but needy populations without regard to the friendliness of their government. (7 U. S. C. 1721)

SEC. 202. The President may authorize the transfer on a grant basis of surplus agricultural commodities from Commodity Credit Corporation stocks to assist programs undertaken with friendly governments or through voluntary relief agencies: *Provided*, That the President shall take reasonable precaution that such transfers will not displace or interfere with sales which might otherwise be made. (7 U. S. C. 1722)

SEC. 203. Not more than \$800,000,000[22] (including the Corporation's investment in the commodities) shall be expended for all such transfers and for other costs authorized by this title. The President may make such transfers through such agencies including intergovernmental organizations, in such manner, and upon such terms and conditions as he deems appropriate; he shall make use of the facilities of voluntary relief agencies to the extent practicable. Such transfers may include delivery f. o. b. vessels in United States ports and, upon a determination by the President that it is necessary to accomplish the purposes of this title or of section 416 of the Agricultural Act of 1949, as amended, ocean freight charges from United States ports to designated ports of entry abroad may be paid from funds available to carry out this title on commodities transferred pursuant

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[18] "December 31, 1959" substituted for "June 30, 1958" by the Act of September 6, 1958, 72 Stat. 1791. "1958" substituted for "1957" by the Act of August 13, 1957, 71 Stat. 345.

[19] See also Pub. L. 85–683 (p. 136) as to flour and cornmeal donations.

[20] Words "or extraordinary" inserted iu two places by the Act of August 3, 1956, 70 Stat. 988.

[21] Requirement that delivery be made "f.o.b. vessels in United States ports" removed by sec. 208 (b) of Agricultural Act of 1956.

[22] "\$800,000,000" substituted for "\$500,000,000" by Pub. L. 85–128, 71 Stat. 345, approved August 13, 1957. "\$500,000,000" substituted for "\$300,000,000" by sec. 208 (c) of the Agricultural Act of 1956.

hereto or donated under said section 416. Funds required for ocean freight costs authorized under this title may be transferred by the Commodity Credit Corporation to such other Federal agency as may be designated by the President. (7 U. S. C. 1723)[23]

SEC. 204. No programs of assistance shall be undertaken under the authority of this title after December 31, 1959. (7 U. S. C. 1724)[24]

TITLE III—GENERAL PROVISIONS

SEC. 301. [This section contains an amendment to section 407 of the Agricultural Act of 1949 (p. 131), authorizing Commodity Credit Corporation to make commodities available to relieve distress.]

SEC. 302. [This section contains a revision of section 416 of the Agricultural Act of 1949 (p. 135), which authorizes various methods of disposition by Commodity Credit Corporation of commodities in surplus supply.]

SEC. 303. The Secretary shall, whenever he determines that such action is in the best interest of the United States, and to the maximum extent practicable, barter or exchange agricultural commodities owned by the Commodity Credit Corporation for (a) such strategic or other materials of which the United States does not domestically produce its requirements and which entail less risk of loss through deterioration or substantially less storage charges as the President may designate, or (b) materials, goods, or equipment required in connection with foreign economic and military aid and assistance programs, or (c) materials or equipment required in substantial quantities for offshore construction programs. He is hereby directed to use every practicable means, in cooperation with other Government agencies, to arrange and make, through private channels, such barters or exchanges or to utilize the authority conferred on him by section 4 (h) of the Commodity Credit Corporation Charter Act, as amended, to make such barters or exchanges. In carrying out barters or exchanges authorized by this section, no restrictions shall be placed on the countries of the free world into which surplus agricultural commodities may be sold, except to the extent that the Secretary shall find necessary in order to take reasonable precautions to safeguard usual marketings of the United States and to assure that barters or exchanges under this Act will not unduly disrupt world prices of agricultural commodities or replace cash sales for dollars. The Secretary may permit the domestic processing of raw materials of foreign origin. The Secretary shall endeavor to cooperate with other exporting countries in preserving normal patterns of commercial trade with respect to commodities covered by formal multilateral international marketing agreements to which the United States is a party. Agencies of the United States Government procuring such materials, goods, or equipment are hereby directed to cooperate with the Secretary in the disposal

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23 Sec. 208 (c) of the Agricultural Act of 1956 provided for payment of other costs authorized by title II (including sec. 416 ocean freight costs) and added last two sentences.

24 "December 31, 1959" substituted for "June 30, 1958" by Pub. L. 85-931, 72 Stat. 1791, approved September 6, 1958. "1958" substituted for "1957" by Pub. L. 85-128, 71 Stat. 345, approved August 13, 1957.

of surplus agricultural commodities by means of barter or exchange. The Secretary is also directed to assist, through such means as are available to him, farmers' cooperatives in effecting exchange of agricultural commodities in their possession for strategic materials. (7 U. S. C. 1692)[25]

SEC. 304. (a) The President shall exercise the authority contained in title I of this Act (1) to assist friendly nations to be independent of trade with the Union of Soviet Socialist Republics and with nations dominated or controlled by the Union of Soviet Socialist Republics and (2) to assure that agricultural commodities sold or transferred thereunder do not result in increased availability of those or like commodities to unfriendly nations.

(b) Nothing in this Act shall be construed as authorizing transactions under title I or title III with the Union of Soviet Socialist Republics or any of the areas dominated or controlled by the Communist regime in China. (7 U. S. C. 1693)[26]

SEC. 305. All Commodity Credit Corporation stocks disposed of under title II of this Act and section 416 of the Agricultural Act of 1949, as amended, shall be clearly identified by, as far as practical, appropriate marking on each package or container as being furnished by the people of the United States of America. (7 U. S. C. 1694)

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[25] As amended by Pub. L. 85-931, 72 Stat. 1791, approved September 6, 1958.

[26] Pub. L. 85-128, 71 Stat. 345, approved August 13, 1957, amended this section by designating the existing provision as subsec. (a), restricting provisions thereof to title I transactions, eliminating the words "for food, raw materials and markets" preceding "and 2", and adding subsec. (b).

Section 32 and Related Statutes

SECTION 32 OF PUBLIC LAW NO. 320, SEVENTY-FOURTH CONGRESS[1]

SEC. 32. There is hereby appropriated for each fiscal year beginning with the fiscal year ending June 30, 1936, an amount equal to 30 per centum of the gross receipts from duties collected under the customs laws during the period January 1 to December 31, both inclusive, preceding the beginning of each such fiscal year.[2] Such sums shall be maintained in a separate fund and shall be used by the Secretary of Agriculture only to (1) encourage the exportation of agricultural commodities and products thereof by the payment of benefits in connection with the exportation thereof or of indemnities for losses incurred in connection with such exportation or by payments to producers in connection with the production of that part of any agricultural commodity required for domestic consumption; (2) encourage the domestic consumption of such commodities or products by diverting them, by the payment of benefits or indemnities or by other means, from the normal channels of trade and commerce or by increasing their utilization through benefits, indemnities, donations or by other means, among persons in low-income groups as determined by the Secretary of Agriculture; and (3) reestablish farmers' purchasing power by making payments in connection with the normal production of any agricultural commodity for domestic consumption. Determinations by the Secretary as to what constitutes diversion and what constitutes normal channels of trade and commerce and what constitutes normal production for domestic consumption shall be final.

The sums appropriated under this section shall be expended for such one or more of the above-specified purposes, and at such times, in such manner, and in such amounts as the Secretary of Agriculture finds will effectuate substantial accomplishment of any one or more of the purposes of this section. Notwithstanding any other provision of this section, the amount that may be devoted, during any fiscal year after June 30, 1939, to any one agricultural commodity or the products thereof in such fiscal year, shall not exceed 25 per

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[1] The Act of August 24, 1935, 49 Stat. 750, 774. Although this section has been amended a number of times, the purposes of sec. 32—through payments or indemnities to encourage the exportation and domestic consumption of agricultural commodities and products and to reestablish farmers' purchasing power in connection with the normal production of agricultural commodities—remain basically as originally enacted. Authority to encourage consumption of agricultural commodities and products by their utilization among persons in low-income groups was added by amendment of clause (2) in 1939 (53 Stat. 975). Later amendments are noted below. Sec. 32 funds may be used (1) to purchase agricultural commodities and products and to donate them for relief purposes under the Act of June 28, 1937 (p. 175) and (2) to donate commodities to schools for utilization in school lunch programs under the National School Lunch Act (p. 243).

[2] Sec. 205 of the Agricultural Act of 1956 (p. 147) authorized the appropriation for each fiscal year, beginning with the fiscal year ending June 30, 1957, of $500,000,000 to enable the Secretary of Agriculture to further carry out the provisions of sec. 32, subject to all provisions of law relating to the expenditure of funds appropriated by such section, except that up to 50 percent of the $500,000,000 may be devoted during any fiscal year to any one agricultural commodity or the products thereof.

centum of the funds available under this section for such fiscal year. The sums appropriated under this section shall be devoted principally to perishable nonbasic agricultural commodities (other than those receiving price support under title II of the Agricultural Act of 1949)[3] and their products.[4] The sums appropriated under this section shall, notwithstanding the provisions of any other law, continue to remain available for the purposes of this section until expended; but any excess of the amount remaining unexpended at the end of any fiscal year over $300,000,000 shall, in the same manner as though it had been appropriated for the service of such fiscal year, be subject to the provisions of section 3690 of the Revised Statutes (U. S. C., title 31, sec. 712), and section 5 of the Act entitled "An Act making appropriations for the legislative, executive, and judicial expenses of the Government for the year ending June thirtieth, eighteen hundred and seventy-five and for other purposes" (U. S. C., title 31, sec. 713).[5] (7 U. S. C. 612c)

ACT OF JUNE 28, 1937, AS AMENDED[6]

AN ACT

To extend the time for purchase and distribution of surplus agricultural commodities for relief purposes and to continue the Federal Surplus Commodities Corporation.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in carrying out the provisions of clause (2) of section 32 of the Act approved August 24, 1935 (49 Stat. 77), as amended, the Secretary of Agriculture may transfer to the Federal Surplus Commodities Corporation,[7] which Corporation is continued, until June 30, 1945, as an agency of the United States under the direction of the Secretary of Agriculture, such funds, appropriated by said section, as may be necessary for the purpose of effectuating clause (2) of said section: *Provided*, That such transferred funds, together with other funds of the Corporation, may be used for purchasing, exchanging, processing, distributing, disposing, transporting, storing, and handling of agricultural commodities and products thereof and inspection costs, commissions, and other incidental costs and expenses, without regard to the provisions of existing law governing the expenditure of public funds and for administrative expenses, including rent, printing and binding, and the employment of persons and means, in the District of Columbia, and elsewhere, such employment of persons to be in accordance with the provisions of law applicable to the employment of persons by the Agricultural Adjustment Administration.

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[3] The clause within the parentheses was substituted for "other than those designated in title II of the Agricultural Act of 1949" by sec. 5 of the Act of January 30, 1954, 68 Stat. 4.

[4] This sentence was added by sec. 411 of the Agricultural Act of 1949.

[5] This sentence was added by sec. 301 of the Agricultural Act of 1948, July 3, 1948, 62 Stat. 1247, 1257.

[6] 50 Stat. 323; February 16, 1938, 52 Stat. 31, 38; June 27, 1942, 56 Stat. 461.

[7] The functions of the Federal Surplus Commodities Corporation have been transferred to the Secretary of Agriculture (7 U. S. C. 612a, note) and the Corporation has been dissolved.

In carrying out clause (2) of section 32, the funds appropriated by said section may be used for the purchase, without regard to the provisions of existing law governing the expenditure of public funds, of agricultural commodities and products thereof, and such commodities, as well as agricultural commodities and products thereof purchased under the preceding paragraph of this section, may be donated for relief purposes and for use in nonprofit summer camps for children.[8] (15 U. S. C. 713c)

UTILIZATION OF COMMODITY CREDIT CORPORATION

Agricultural Act of 1949—Sec. 404. The Secretary, in carrying out programs under section 32 of Public Law Numbered 320, Seventy-fourth Congress, approved August 24, 1935, as amended, and section 6 of the National School Lunch Act, may utilize the services and facilities of the Commodity Credit Corporation (including but not limited to procurement by contract), and make advance payments to it. (7 U. S. C. 1424)

ACT OF AUGUST 11, 1939 [9]

AN ACT

To authorize the Federal Surplus Commodities Corporation to purchase and distribute surplus products of the fishing industry.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That any part of the funds not to exceed $1,500,000 per year, transferred by the Secretary of Agriculture to the Federal Surplus Commodities Corporation[10] created under and to carry out the provisions of section 32 of the Act of August 24, 1935 (49 Stat. 774), as amended, may also be used by such Corporation for the purpose of diverting surplus fishery products (including fish, shellfish, mollusks, and crustacea) from the normal channels of trade and commerce by acquiring them and providing for their distribution through Federal, State, and private relief channels: *Provided*, That none of the funds made available to the Federal Surplus Commodities Corporation under this Act shall be used to purchase any of the commodities designated in this Act which may have been produced in any foreign country. The provisions of law relating to the acquisition of materials or supplies for the United States shall not apply to the acquisition of commodities under this Act. (15 U. S. C. 713c–2)

SEC. 2. (a) The Secretary of Agriculture shall transfer to the Secretary of the Interior each fiscal year, beginning with the fiscal year commencing July 1, 1954, and ending on June 30, 1957,[11] from

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[8] The last 9 words were added by Pub. L. 85–483, 72 Stat. 286, approved July 2, 1958.

[9] 53 Stat. 1411.

[10] The functions of the Federal Surplus Commodities Corporation have been transferred to the Secretary of Agriculture (7 U. S. C. 612a note) and the Corporation has been dissolved.

[11] Sec. 12 (a) of the Act of August 8, 1956 (70 Stat. 1124, 15 U. S. C. 713c–3 note) provides:

"The authorization for the transfer of certain funds from the Secretary of Agriculture to the Secretary of the Interior and their maintenance in a separate fund as contained in section 2 (a) of the Act of August 11, 1939, as amended July 1, 1954 (68 Stat. 376), shall be continued for the year ending June 30, 1957, and each year thereafter."

moneys made available to carry out the provisions of section 32 of such Act of August 24, 1935, an amount equal to 30 per centum of the gross receipts from duties collected under the customs laws on fishery products (including fish, shellfish, mollusks, crustacea, aquatic plants and animals, and any products thereof, including processed and manufactured products), which shall be maintained in a separate fund and used by the Secretary of the Interior (1) to promote the free flow of domestically produced fishery products in commerce by conducting a fishery educational service and fishery technological, biological and related research programs, the moneys so transferred to be also available for the purchase or other acquisition, construction, equipment, operation, and maintenance of vessels or other facilities necessary for conducting research as provided for in this section, and (2) to develop and increase markets for fishery products of domestic origin and (3) to conduct any biological, technological, or other research pertaining to American fisheries.

(b) For the purposes of this section, any agency of the United States, or any corporation wholly owned by the United States, is authorized to transfer, without reimbursement or transfer of funds, any vessels or equipment excess to its needs required by the Secretary of the Interior for the activities, studies, and research authorized herein.

(c) In carrying out the purposes and objectives of this section, the Secretary of the Interior is directed as far as practicable to cooperate with other appropriate agencies of the Federal Government, with State or local governmental agencies, private agencies, organizations, or individuals, having jurisdiction over or an interest in fish or fishery commodities and he is authorized to appoint an advisory committee of the American fisheries industry to advise him in the formulation of policy, rules and regulations pertaining to requests for assistance, and other matters.

(d) The Secretary of the Interior is further authorized to retransfer any of the funds not to exceed $1,500,000 to be made available under this section to the Secretary of Agriculture to be used for the purposes specified in section 1 of this Act, and only such funds as are thus transferred shall be used for the purposes specified in section 1 of this Act with respect to domestically produced fishery products.

(e) The separate fund created for the use of the Secretary of the Interior under section 2 (a) of this Act and the annual accruals thereto shall be available for each year until expended by the Secretary.

(f) The Secretary of the Interior shall make a report to the appropriate committees of Congress annually on the use of the separate fund created under section 2 of this Act. (15 U. S. C. 713c–3)[12]

ACT OF SEPTEMBER 6, 1958

SEC. 9. Notwithstanding any other provision of law (1) those areas under the jurisdiction or administration of the United States are authorized to receive from the Department of Agriculture for

[12] The provisions of this section were substituted for the original provisions by the Act of July 1, 1954, 68 Stat. 376. Subsection (e) was amended by the Act of August 8, 1956, 70 Stat. 1124.

distribution on the same basis as domestic distribution in any State, Territory, or possession of the United States, without exchange of funds, such surplus commodities as may be available pursuant to clause (2) of section 32 of the Act of August 24, 1935, as amended (7 U. S. C. 612c), and section 416 of the Agricultural Act of 1949, as amended (7 U. S. C. 1431); and (2) the Commodity Credit Corporation is authorized to purchase products of oil seeds, and edible oils and fats and the products thereof in such form as may be needed for donation abroad as provided in the following sentence. Any such commodities or products if purchased shall be donated to nonprofit voluntary agencies registered with the Department of State, other appropriate agencies of the Federal Government or international organizations for use in the assistance of needy persons outside the United States. Commodity Credit Corporation may incur such additional costs with respect to such oil as it is authorized to incur with respect to food commodities disposed of under section 416 of the Agricultural Act of 1949. (72 Stat. 1792)

DEPARTMENT OF THE INTERIOR AND RELATED AGENCIES APPROPRIATION ACT, 1959

Trust Territory of the Pacific Islands— * * * *Provided further*, That notwithstanding the provisions of any law, the Trust Territory of the Pacific Islands is authorized to receive, during the current fiscal year, from the Department of Agriculture for distribution on the same basis as domestic distribution in any State, Territory, or possession of the United States, without exchange of funds, such surplus food commodities as may be available pursuant to section 32 of the Act of August 24, 1935, as amended (7 U. S. C. 612c), and section 416 of the Agricultural Act of 1949, as amended (7 U. S. C. 1431). (72 Stat. 164)

INTERNATIONAL WHEAT AGREEMENT ACT OF 1949,[1] AS AMENDED

AN ACT

To give effect to the International Wheat Agreement signed by the United States and other countries relating to the stabilization of supplies and prices in the international wheat market.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act shall be known as the "International Wheat Agreement Act of 1949." (7 U. S. C. 1641 note)

SEC. 2. The President is hereby authorized, acting through the Commodity Credit Corporation, to make available or cause to be made available, notwithstanding the provisions of any other law, such quantities of wheat and wheat-flour and at such prices as are necessary to exercise the rights, obtain the benefits, and fulfill the obligations of the United States under the International Wheat Agreement of 1949 signed by Australia, Canada, France, the United States, and Uruguay, and certain wheat importing countries and the agreement revising and renewing the International Wheat Agreement for a period ending July 31, 1956, signed by Australia, Canada, France, the United States, and certain wheat importing countries and the Agreement (International Wheat Agreement, 1956) further revising and renewing the International Wheat Agreement for a period ending July 31, 1959, signed by Argentina, Australia, Canada, France, Sweden, the United States, and certain wheat importing countries[2] (hereinafter called "International Wheat Agreement"). Nothing herein shall be construed to preclude the Secretary of Agriculture, in carrying out programs to encourage the exportation of agricultural commodities and products thereof pursuant to section 32 of Public Law 320, Seventy-fourth Congress, as amended, from utilizing funds available for such programs in such manner as, either separately or jointly with the Commodity Credit Corporation,

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[1] Approved October 27, 1949, 63 Stat. 945. The original International Wheat Agreement was a contractual arrangement between the governments of 4 wheat-exporting countries and 42 wheat-importing countries involving the annual trade of 580,916,690 bushels of wheat over a period of 4 years beginning August 1, 1949, within a fixed range of prices. The agreement was ratified by the President with the advice and consent of the Senate (Ex. M, 81st Cong., 1st sess.). The International Wheat Agreement Act of 1949 was implementing legislation authorizing the necessary action to carry out the terms of this agreement.

The International Wheat Agreement was renewed for a period of 3 years beginning August 1, 1953. The International Wheat Agreement, 1956, renewed the 1949 agreement through July 31, 1959. It provides for the annual trade of 302,915,145 bushels of wheat and has been ratified by 6 exporting and 39 importing countries up to this time. This agreement was ratified by the President with the advice and consent of the Senate (Ex. I, 84th Cong., 2d sess.). The International Wheat Agreement Act of 1949 has been amended to authorize the necessary action to carry out the terms of the revised agreement.

[2] The reference to the revised agreement was added by the Act of August 1, 1953, 67 Stat. 358. The reference to the second revision was added by the Act of August 3, 1956, 70 Stat. 966.

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to exercise the rights, obtain the benefits, and fulfill all or any part of the obligations of the United States under the International Wheat Agreement or to preclude the Commodity Credit Corporation in otherwise carrying out wheat and wheat-flour export programs as authorized by law. Nothing contained herein shall limit the duty of the Commodity Credit Corporation to the maximum extent practicable consistent with the fulfillment of the Corporation's purposes and the effective and efficient conduct of its business to utilize the usual and customary channels, facilities, and arrangements of trade and commerce in making available or causing to be made available wheat and wheat-flour hereunder. The pricing provisions of section 112 (e) of the Economic Cooperation Act of 1948 and section 4 of the Act of July 16, 1943 (57 Stat. 566), shall not be applicable to domestic wheat and wheat-flour supplied to countries which are parties to the International Wheat Agreement and credited to their guaranteed purchases thereunder on and after August 1, 1949, and up to and including June 30, 1950.[3] Where prices in excess of the International Wheat Agreement prices have been paid for such wheat and wheat-flour financed by the Economic Cooperation Administration on or after August 1, 1949, and up to and including June 30, 1950, the Secretary of Agriculture or Commodity Credit Corporation is authorized to reimburse the Economic Cooperation Administration for such excess amounts. Funds realized from such reimbursement shall revert to the respective appropriation or appropriations from which funds were expended for the procurement of such wheat and wheat-flour. There are hereby authorized to be appropriated such sums as may be necessary to make payments to the Commodity Credit Corporation of its estimated or actual net costs of carrying out its functions hereunder.[4] The Commodity Credit Corporation is hereby authorized in carrying out its functions hereunder to utilize, in advance of such appropriations or payments, any assets available to it. (7 U. S. C. 1641)

SEC. 3. (a) The President is hereby further authorized to take such other action, including prohibiting or restricting the importation or exportation of wheat or wheat-flour and to issue such rules or regulations which shall have the force and effect of law, as may be necessary in his judgment in the implementation of the International Wheat Agreement. (7 U. S. C. 1642 (a))

(b) All persons exporting or importing wheat or wheat-flour or selling wheat or wheat-flour for export shall report to the President such information as he may from time to time require and keep such records as he finds to be necessary to enable him to carry out the purposes of this Act. Such information shall be reported and such records shall be kept in accordance with such regulations as the President may prescribe. For the purposes of ascertaining the correctness of any report made or record kept, or of obtaining infor-

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[3] Sec. 112 (m) of the Economic Cooperation Act of 1948 (as added by the Act of June 5, 1950, 67 Stat. 198, 200; 22 U. S. C. 1510 (m)) provides:

"(m) Notwithstanding any other provision of law, the pricing provisions of section 112 (e) of this title and section 4 of the Act of July 16, 1943 (57 Stat. 566) shall not be applicable to domestic wheat and wheat flour procured under this title or any other Act providing for assistance or relief to foreign countries, supplied to countries which are parties to the International Wheat Agreement of 1949 and credited to their guaranteed purchases thereunder."

[4] Several appropriations have been made pursuant to this provision.

mation required to be furnished in any report, but not so furnished, the President is hereby authorized to examine such books, papers, records, accounts, correspondence, contracts, documents, and memoranda as are relevant to transactions under the International Wheat Agreement and are within the control of any such person. (7 U. S. C. 1642 (b))

(c) Any person failing to make any report or keep any record as required by or pursuant to this section 3, or making any false report or record or knowingly violating any rule or regulation of the President issued pursuant to this Section 3 shall be deemed guilty of a misdemeanor and upon conviction thereof shall be subject to a fine of not more than $1,000 for each violation. (7 U. S. C. 1642 (c))

(d) Any person who knowingly and willfully exports wheat or wheat-flour from the United States, or who knowingly and willfully imports wheat or wheat-flour into the United States for consumption therein, in excess of the quantity of wheat or wheat-flour permitted to be exported or imported, as the case may be, under regulations issued by the President shall forfeit to the United States a sum equal to two times the market value at the time of the commission of any such act, of the quantity of wheat or wheat-flour by which any such exportation or importation exceeds the authorized amount which forfeiture shall be recoverable in a civil suit brought in the name of the United States. (7 U. S. C. 1642 (d))

(e) The district courts of the United States and the District Court of the United States for the District of Columbia shall have jurisdiction of violations of this Act or the rules and regulations thereunder, and of all suits in equity and actions at law brought to enforce any liability or duty created by this Act or the rules and regulations thereunder. Any criminal proceeding may be brought in the district wherein any act or transaction constituting the violation occurred. Any suit or action to enforce any liability or duty created by this Act or rules and regulations thereunder, or to enjoin any violation of such Act or rules and regulations, may be brought in any such district wherein the defendant is found or is a resident or transacts business. The remedies, fines, and forfeitures provided for in this Act shall be in addition to, and not exclusive of, any of the remedies, fines, and forfeitures under existing law. (7 U. S. C. 1642 (e))

(f) Any power, authority, or discretion conferred on the President by this Act may be exercised through such department, agency, or officer of the Government as the President may direct, and shall be exercised in conformity with such rules or regulations as he may prescribe. (7 U. S. C. 1642 (f))

(g) There are hereby authorized to be appropriated such sums as may be necessary to carry out the provisions of this section, including the necessary expenses and contributions of the United States in connection with the administration of the International Wheat Agreement. (7 U. S. C. 1642 (g))

(h) Funds appropriated under authority of this Act may be used for the purchase or hire of passenger motor vehicles, for printing and binding, for rent and personal services in the District of Columbia and elsewhere without regard to the limitation contained in section 607 (g) of the Federal Employees Pay Act of 1945, as

amended,[5] and for the employment of experts or consultants or organization thereof, on a temporary basis, by contract or otherwise, without regard to the Classification Act, at rates not in excess of $50 per diem. (7 U. S. C. 1642 (h))

(i) The functions exercised under authority of this Act shall be excluded from the operation of the Administrative Procedure Act (60 Stat. 237) except as to the requirements of sections 3 and 10 thereof. (7 U. S. C. 1642 (i))

(j) The term "person" as used in this section shall include the singular and the plural and any individual, partnership, corporation, association, or any other organized group of persons. (7 U. S. C. 1642 (j))

[Act of August 1, 1953—Sec. 2. Reference in any law to the International Wheat Agreement of 1949 shall be deemed to include the agreement revising and renewing the International Wheat Agreement. (67 Stat. 358; 7 U. S. C. 1641 note)]

[Act of August 3, 1956—Sec. 2. Reference in any law to the International Wheat Agreement of 1949 shall be deemed to include the Agreement (International Wheat Agreement, 1956) revising and renewing the International Wheat Agreement for a period ending July 31, 1959. (70 Stat. 966; 7 U. S. C. 1641 note)]

[5] Sec. 607 (g) was repealed September 12, 1950, 64 Stat. 843.

FEDERAL CROP INSURANCE ACT, AS AMENDED

EXPLANATORY NOTE

The Federal Crop Insurance Act, which was enacted as title V of the Agricultural Adjustment Act of 1938 (52 Stat. 72), established the Federal Crop Insurance Corporation to insure producers of wheat against unavoidable losses in production resulting from adverse weather conditions, disease, insect infestation and other hazards. In 1941, the Act was amended to authorize the Corporation to insure cotton as well as wheat (55 Stat. 255). The Congress did not provide funds for insurance on crops harvested in 1944 but in December 1944, the insurance program was reinstated as to wheat and cotton and extended to permit the insuring of flax on a national basis and other commodities on an experimental basis (58 Stat. 918). In 1947, the Congress made a number of basic changes in the nature and scope of the crop insurance program the more important of which (1) placed crop insurance entirely on an experimental basis by restricting the number of commodities for which the Corporation could write insurance and the number of counties in which insurance could be offered; and (2) limited the level of insurance that could be provided to the general cost of producing the insured crop (61 Stat. 718). The Act was again amended in 1949 to permit the Corporation to expand through 1953 and to operate more efficiently the experimental program initiated by the 1947 legislation (63 Stat. 663). A 1953 amendment permits continued expansion by authorizing insurance in 100 additional counties each year (67 Stat. 575). The Act of August 3, 1956, 70 Stat. 1034, authorized the Corporation to consider certain costs as non-administrative and to use premium income for administrative expenses within limits prescribed by applicable legislation. Pub. L. 85–111, 71 Stat. 309, July 23, 1957 added a new subsection (b) to section 508 to provide reinsurance in Puerto Rico under certain conditions.

PART V

FEDERAL CROP INSURANCE ACT, AS AMENDED

SHORT TITLE AND APPLICATION OF OTHER PROVISIONS

SEC. 501. This title may be cited as the "Federal Crop Insurance Act." Except as otherwise expressly provided the provisions in titles I to IV, inclusive, shall not apply with respect to this title, and the term "Act" wherever it appears in such titles shall not be construed to include this title.[1] (7 U. S. C. 1501)

DECLARATION OF PURPOSE

SEC. 502. It is the purpose of this title to promote the national welfare by improving the economic stability of agriculture through a sound system of crop insurance and providing the means for the research and experience helpful in devising and establishing such insurance. (7 U. S. C. 1502)

SEC. 503. To carry out the purposes of this title, there is hereby created as an agency of and within the Department of Agriculture a body corporate with the name "Federal Crop Insurance Corporation" (herein called the Corporation). The principal office of the Corporation shall be located in the District of Columbia, but there may be established agencies or branch offices elsewhere in the United States under rules and regulations prescribed by the Board of Directors. (7 U. S. C. 1503)

CAPITAL STOCK

SEC. 504. (a) The Corporation shall have a capital stock of $100,000,000 subscribed by the United States of America, payment for which shall, with the approval of the Secretary of Agriculture, be subject to call in whole or in part by the Board of Directors of the Corporation. (7 U. S. C. 1504 (a))

(b) There is hereby authorized to be appropriated such sums as are necessary for the purpose of subscribing to the capital stock of the Corporation. (7 U. S. C. 1504 (b))

(c) Receipts for payments by the United States of America for or on account of such stock shall be issued by the Corporation to the Secretary of the Treasury and shall be evidence of the stock ownership by the United States of America. (7 U. S. C. 1504 (c))

MANAGEMENT OF CORPORATION

SEC. 505. (a) The management of the Corporation shall be vested in a Board of Directors (hereinafter called the "Board") subject to

[1] The Federal Crop Insurance Act was enacted as title V of the Agricultural Adjustment Act of 1938.

the general supervision of the Secretary of Agriculture. The Board shall consist of the manager of the Corporation, two other persons employed in the Department of Agriculture, and two persons experienced in the insurance business who are not otherwise employed by the Government. The Board shall be appointed by, and hold office at the pleasure of the Secretary of Agriculture, who shall not, himself, be a member of the Board. (7 U. S. C. 1505 (a))

(b) Vacancies in the Board so long as there shall be three members in office shall not impair the powers of the Board to execute the functions of the Corporation, and three of the members in office shall constitute a quorum for the transaction of the business of the Board. (7 U. S. C. 1505 (b))

(c) The Directors of the Corporation who are employed in the Department of Agriculture shall receive no additional compensation for their services as such Directors, but may be allowed necessary traveling and subsistence expenses when engaged in business of the Corporation, outside of the District of Columbia. The members of the Board who are not employed by the Government shall be paid such compensation for their services as directors as the Secretary of Agriculture shall determine, but such compensation shall not exceed $50 per day each when actually employed and transportation expenses plus not to exceed $10 per diem in lieu of subsistence expenses when on business of the Corporation away from their homes or regular places of business. (7 U. S. C. 1505 (c))

(d) The manager of the Corporation shall be its chief executive officer, with such power and authority as may be conferred upon him by the Board. He shall be appointed by, and hold office at the pleasure of, the Secretary of Agriculture. (7 U. S. C. 1505 (d))

GENERAL POWERS

Sec. 506. The Corporation—

(a) shall have succession in its corporate name; (7 U. S. C. 1506 (a))

(b) may adopt, alter, and use a corporate seal, which shall be judicially noticed; (7 U. S. C. 1506 (b))

(c) may make contracts and purchase or lease and hold such real and personal property as it deems necessary or convenient in the transaction of its business, and may dispose of such property held by it upon such terms as it deems appropriate; (7 U. S. C. 1506 (c))

(d) subject to the provisions of section 508 (c), may sue and be sued in its corporate name in any court of record of a State having general jurisdiction, or in any United States district court, and jurisdiction is hereby conferred upon such district court to determine such controversies without regard to the amount in controversy: *Provided*, That no attachment, injunction, garnishment, or other similar process, mesne or final, shall be issued against the Corporation or its property; (7 U. S. C. 1506 (d))

(e) may adopt, amend, and repeal bylaws, rules, and regulations governing the manner in which its business may be conducted and the powers granted to it by law may be exercised and enjoyed; 7 U. S. C. 1506 (e))

(f) shall be entitled to the free use of the United States mails in the same manner as the other executive agencies of the Government; (7 U. S. C. 1506 (f)

(g) with the consent of any board, commission, independent establishment, or executive department of the Government, including any field service thereof, may avail itself of the use of information, services, facilities, officials, and employees thereof in carrying out the provisions of this title; (7 U. S. C. 1506 (g))

(h) may conduct researches, surveys, and investigations relating to crop insurance and shall assemble data for the purpose of establishing sound actuarial bases for insurance on agricultural commodities; (7 U. S. C. 1506 (h))

(i) shall determine the character and necessity for its expenditures under this title and the manner in which they shall be incurred, allowed, and paid, without regard to the provisions of any other laws governing the expenditure of public funds and such determinations shall be final and conclusive upon all other officers of the Government; (7 U. S. C. 1506 (i))

(j) shall have such powers as may be necessary or appropriate for the exercise of the powers herein specifically conferred upon the Corporation and all such incidental powers as are customary in corporations generally. (7 U. S. C. 1506 (j))

PERSONNEL

SEC. 507. (a) The Secretary shall appoint such officers and employees as may be necessary for the transaction of the business of the Corporation pursuant to civil-service laws and regulations, fix their compensation in accordance with the provisions of the [Classification Act of 1949 (5 U. S. C. 1071–1153], define their authority and duties, delegate to them such of the powers vested in the Corporation as he may determine, require bond of such of them as he may designate, and fix the penalties and pay the premiums of such bonds: *Provided*, That personnel paid by the hour, day, or month when actually employed, and county crop insurance committeemen may be appointed and their compensation fixed without regard to civil-service laws and regulations or the [Classification Act of 1949]. (7 U. S. C. 1507 (a))

(b) Insofar as applicable, the benefits of the Act entitled "An Act to provide compensation for employees of the United States suffering injuries while in the performance of their duties, and for other purposes," approved September 7, 1916, as amended, shall extend to persons given employment under the provisions of this title, including the employees of the committees and associations referred to in subsection (c) of this section and the members of such committees. (7 U. S. C. 1507 (b))

(c) The Board may establish or utilize committees or associations of producers in the administration of this title and make payments to such committees or associations to cover the estimated administrative expenses to be incurred by them in cooperating in carrying out this title and may provide that all or part of such estimated expenses may be included in the insurance premiums provided for in this title. (7 U. S. C. 1507 (c))

(d) The Secretary of Agriculture may allot to bureaus and offices of the Department of Agriculture or transfer to such other agencies of the State and Federal Governments as he may request to assist in carrying out this title any funds made available pursuant to the provisions of section 516 of this Act, except that employees or agencies responsible for administering this Act in each county shall be selected and designated by the Corporation and shall be responsible directly to the Corporation without the intervention of any intermediate office or agency. (7 U. S. C. 1507 (d))

(e) In carrying out the provisions of this title the Board may, in its descretion, utilize producer-owned and producer-controlled cooperative associations. (7 U. S. C. 1507 (e))

CROP INSURANCE

SEC. 508. To carry out the purposes of this title the Corporation is authorized and empowered—

(a) Commencing with crops planted for harvest in 1948, for the purpose of determining the most practical plan, terms, and conditions of insurance for agricultural commodities, if sufficient actuarial data are available, as determined by the Board, to insure, or to reinsure insurers of, producers of such agricultural commodities under any plan or plans of insurance determined by the Board to be adapted to any such commodity. Such insurance shall be against loss of the insured commodity due to unavoidable causes, including drought, flood, hail, wind, frost, winterkill, lightning, fire, excessive rain, snow, wildlife, hurricane, tornado, insect infestation, plant disease, and such other unavoidable causes as may be determined by the Board: *Provided*, That, except in the case of tobacco, such insurance shall not extend beyond the period the insured commodity is in the field. In 1948 insurance shall be limited to not more than seven agricultural commodities (including wheat, cotton, flax, corn, and tobacco) and to not more than three additional agricultural commodities in each year thereafter: *Provided*, That other agricultural commodities may be included in multiple crop insurance (insurance on two or more agricultural commodities under one contract with a producer). Beginning with crops planted for harvest in 1954, crop insurance may be offered each year in not to exceed 100 counties in addition to the number of counties in which such insurance was offered in the preceding year. In determining the new counties in which such insurance is to be offered and the commodities to be insured, the Corporation shall take into consideration the demand of farmers for such insurance, the extent to which such insurance is available to commercial producers of insured commodities, and the anticipated risk of loss to the Corporation. Reinsurance for private insurance companies shall be limited to not to exceed twenty counties which may be selected without regard to the other county limitations specified herein. Any insurance offered against loss in yield shall not cover in excess of 75 per centum of the recorded or appraised average yield of the commodity on the insured farm for a representative period subject to such adjustments as the Board may prescribe to the end that the average yields fixed for farms in the same area, which are subject to the same conditions, may be fair and

just: *Provided*, That if 75 per centum of the average yield represents generally more protection than the investment in the crop in any area, taking into consideration recognized farming practices, the Board shall reduce such maximum percentage so as more nearly to reflect the investment in the crop in such area. Insurance provided under this subsection shall not cover losses due to the neglect or malfeasance of the producer, or to the failure of the producer to reseed to the same crop in areas and under circumstances where it is customary to so reseed, or to the failure of the producer to follow established good farming practices. Counties selected by the Board shall be representative of the several areas where the agricultural commodity insured is normally produced. The Board may limit or refuse insurance in any county or area, or on any farm, on the basis of the insurance risk involved. Insurance shall not be provided in any county unless written applications therefor are filed covering at least two hundred farms or one-third of the farms normally producing the agricultural commodity, excluding farms refused insurance on the basis of the risk involved; nor shall insurance on any agricultural commodity be provided in any county in which the Board determines that the income from such commodity constitutes an unimportant part of the total agricultural income of the county, except that insurance may be provided for producers on farms situated in a local producing area bordering on a county with a crop-insurance program. The Corporation shall report annually to the Congress the results of its operations as to each commodity insured. (7 U. S. C. 1508 (a))

(b) To fix adequate premiums for insurance in the agricultural commodity or in cash, at such rates as the Board deems sufficient to cover claims for crop losses on such insurance and to establish as expeditiously as possible a reasonable reserve against unforeseen losses: *Provided*, That such premiums may be established on the basis of the parity or comparable price for the commodity as determined and published by the Secretary of Agriculture, or on the basis of an average market price designated by the Board. Such premiums shall be collected at such time or times, or shall be secured in such manner, as the Board may determine. (7 U. S. C. 1508 (b))

(c) To adjust and pay claims for losses in the agricultural commodity or in cash, under rules prescribed by the Board: *Provided*, That indemnities may be determined on the same price basis as premiums are determined for the crop with respect to which such indemnities are paid. The Corporation shall provide for the posting annually in each county at the county courthouse of a list of indemnities paid for losses on farms in such county. In the event that any claim for indemnity under the provisions of this title is denied by the Corporation, an action on such claim may be brought against the Corporation in the United States district court, or in any court of record of the State having general jurisdiction, sitting in the district or county in which the insured farm is located, and jurisdiction is hereby conferred upon such district courts to determine such controversies without regard to the amount in controversy: *Provided*, That no suit on such claim shall be allowed under this section unless the same shall have been brought within one year

after the date when notice of denial of the claim is mailed to and received by the claimant. (7 U. S. C. 1508 (c))

(d) From time to time, in such manner and through such agencies as the Board may determine, to purchase, handle, store, insure, provide storage facilities for, and sell the agricultural commodity, and pay any expenses incidental thereto, it being the intent of this provision, however, that, insofar as practicable, the Corporation shall purchase the agricultural commodity only at the rate and to a total amount equal to the payment of premiums in cash by farmers or to replace promptly the agricultural commodity sold to prevent deterioration; and shall sell the agricultural commodity only to the extent necessary to cover payments of indemnities and to prevent deterioration: *Provided, however*, That nothing in this section shall prevent prompt offset purchases and sales of the agricultural commodity for convenience in handling. Nothing in this section shall prevent the Corporation from accepting, for the payment of premiums, notes payable in the commodity insured, or the cash equivalent, upon such security as may be determined pursuant to subsection (b) of this section, and from purchasing the quantity of the commodity represented by any of such notes not paid at maturity. The restriction on the purchase and sale of the agricultural commodity provided in this section shall be made a part of any crop insurance agreement made under this title. Notwithstanding any provision of this title, there shall be no limitation upon the legal or equitable remedies available to the insured to enforce against the Corporation the foregoing restriction with respect to purchases and sales of the agricultural commodity. (7 U. S. C. 1508 (d))

(e) In connection with insurance upon yields of cotton, to include provision for additional premium and indemnity in terms of lint cotton to cover loss of cottonseed, such additional premium and indemnity to be determined on the basis of the average relationship between returns from cottonseed and returns from lint cotton for the same period of years as that used for computing yields and premium rates. (7 U. S. C. 1508 (e))

(f) Notwithstanding any other provision of this title, the corporation is hereby authorized, under such terms and conditions as it deems consistent with sound reinsurance principles, to provide reinsurance on any crop or plantation insurance provided in Puerto Rico by a duly authorized agency of the Commonwealth of Puerto Rico: *Provided*, That, no application for reinsurance authorized herein shall be approved, unless the corporation shall have determined that the reinsurance deemed necessary is not available from recognized private sources at reasonable cost.[2] (7 U. S. C. 1508 (f))

INDEMNITIES EXEMPT FROM LEVY

SEC. 509. Claims for indemnities under this title shall not be liable to attachment, levy, garnishment, or any other legal process before payment to the insured or to deduction on account of the indebtedness of the insured or his estate to the United States except claims of the United States or the Corporation arising under this title. (7 U. S. C. 1509)

[2] New subsection (f) added by Pub. L. 85–111, 71 Stat. 309, July 23, 1957.

DEPOSIT OF FUNDS

Sec. 510. All money of the Corporation not otherwise employed may be deposited with the Treasurer of the United States or in any bank approved by the Secretary of the Treasury, subject to withdrawal by the Corporation at any time, or with the approval of the Secretary of the Treasury may be invested in obligations of the United States or in obligations guaranteed as to principal and interest by the United States. Subject to the approval of the Secretary of the Treasury, the Federal Reserve banks are hereby authorized and directed to act as depositories, custodians, and fiscal agents for the Corporation in the performance of its powers conferred by this title. (7 U. S. C. 1510)

TAX EXEMPTIONS

Sec. 511. The Corporation, including its franchise, its capital, reserves, and surplus, and its income and property, shall be exempt from all taxation now or hereafter imposed by the United States or by any Territory, dependency, or possession thereof, or by any State, county, municipality or local taxing authority. (7 U. S. C. 1511)

FISCAL AGENT OF GOVERNMENT

Sec. 512. When designated for that purpose by the Secretary of the Treasury, the Corporation shall be a depository of public money, except receipts from customs, under such regulations as may be prescribed by said Secretary; and it may also be employed as a financial agent of the Government; and it shall perform all such reasonable duties, as a depository of public money and financial agent of the Government, as may be required of it. (7 U. S. C. 1512)

ACCOUNTING BY CORPORATION

Sec. 513. The Corporation shall at all times maintain complete and accurate books of account and shall file annually with the Secretary of Agriculture a complete report as to the business of the Corporation. The financial transactions of the Corporation shall be audited at least once each year by the General Accounting Office for the sole purpose of making a report to Congress, together with such recommendations as the Comptroller General of the United States may deem advisable: *Provided*, That such report shall not be made until the Corporation shall have had reasonable opportunity to examine the exceptions and criticisms of the Comptroller General or the General Accounting Office, to point out errors therein, explain or answer the same, and to file a statement which shall be submitted by the Comptroller General with his report. (7 U. S. C. 1513)

CRIMES AND OFFENCES

Sec. 514. (Subsections (a) through (e) repealed by 62 Stat. 859.) (See criminal provisions beginning on p. 191)

(f) The provisions of section 22 of Title 41 shall not apply to any crop insurance agreements made under this title. (7 U. S. C. 1514 (f))

ADVISORY COMMITTEE

SEC. 515. The Secretary of Agriculture is authorized to appoint from time to time an advisory committee, consisting of not more than five members experienced in agricultural pursuits and appointed with due consideration to their geographical distribution, to advise the Corporation with respect to carrying out the purposes of this title. The compensation of the members of such committee shall be determined by the Board but shall not exceed $10 per day each while actually employed and actual necessary traveling and subsistence expenses, or a per diem allowance in lieu thereof. (7 U. S. C. 1515)

APPROPRIATIONS AND REGULATIONS

SEC. 516. (a) There are hereby authorized to be appropriated such sums, not in excess of $12,000,000 for each fiscal year beginning after June 30, 1938, as may be necessary to cover the operating and administrative costs of the Corporation, which shall be allotted to the Corporation in such amounts and at such time or times as the Secretary of Agriculture may determine: *Provided*, That expenses in connection with the purchase, transportation, handling, or sale of the agricultural commodity and the direct cost of loss adjusters for crop inspections and loss adjustments may be considered by the Corporation as being non-administrative or nonoperating expenses. The Corporation is authorized to use premium income for administrative and operating costs within limits prescribed in applicable appropriations. (7 U. S. C. 1516 (a))

(b) The Secretary and the Corporation, respectively, are authorized to issue such regulations as may be necessary to carry out the provisions of this title. (7 U. S. C. 1516 (b))

SEPARABILITY

SEC. 517. The sections of this title and subdivisions of sections are hereby declared to be separable, and in the event any one or more sections or parts of the same of this title be held to be unconstitutional, the same shall not affect the validity of other sections or parts of sections of this title. (7 U. S. C. 1517)

SEC. 518. "Agricultural commodity," as used in this title, means wheat, cotton, flax, corn, dry beans, oats, barley, rye, tobacco, rice, peanuts, soybeans, sugar beets, sugarcane, timber and forests, potatoes and other vegetables, citrus and other fruits, tame hay, or any other agricultural commodity determined by the Board pursuant to subsection (a) of section 508 of this title, or any one or more of such commodities, as the context may indicate. (7 U. S. C. 1518)

RIGHT TO AMEND

SEC. 519. The right to alter, amend, or repeal this title is hereby reserved. (7 U. S. C. 1519)

CRIMINAL PROVISIONS APPLICABLE TO FEDERAL CROP INSURANCE CORPORATION

Whoever, being an officer, agent or employee of or connected in any capacity with the Reconstruction Finance Corporation, Federal

Deposit Insurance Corporation, Home Owners' Loan Corporation, Farm Credit Administration, Federal Housing Administration, Federal Farm Mortgage Corporation, Federal Crop Insurance Corporation, Farmers' Home Corporation or any land bank, intermediate credit bank, bank for cooperatives or any lending, mortgage, insurance, credit or savings and loan corporation or association authorized or acting under the laws of the United States, and whoever, being a receiver of any such institution, or agent or employee of the receiver, embezzles, abstracts, purloins or willfully misapplies any moneys, funds, credits, securities or other things of value belonging to such institution, or pledged or otherwise intrusted to its care, shall be fined not more than $5,000 or imprisoned not more than five years, or both; but if the amount or value embezzled, abstracted, purloined or misapplied does not exceed $100, he shall be fined not more than $1,000 or imprisoned not more than one year, or both. (18 U. S. C. 657)

Whoever, with intent to defraud, knowingly conceals, removes, disposes of, or converts to his own use or to that of another any property mortgaged or pledged to, or held by, the Farm Credit Administration, any Federal intermediate credit bank, or the Federal Farm Mortgage Corporation, Federal Crop Insurance Corporation, Farmers' Home Corporation, or any production credit corporation or corporation in which a production credit corporation holds stock, any regional agricultural credit corporation, or any bank for cooperatives, shall be fined not more than $5,000 or imprisoned not more than five years, or both; but if the value of such property does not exceed $100, he shall be fined not more than $1,000 or imprisoned not more than one year, or both. (18 U. S. C. 658)

Whoever, being an officer, agent or employee of or connected in any capacity with the Reconstruction Finance Corporation, Federal Deposit Insurance Corporation, Home Owners' Loan Corporation, Farm Credit Administration, Federal Housing Administration, Federal Farm Mortgage Corporation, Federal Crop Insurance Corporation, Farmers' Home Corporation, or any land bank, intermediate credit bank, bank for cooperatives or any lending, mortgage, insurance, credit or savings and loan corporation or association authorized or acting under the laws of the United States, with intent to defraud any such institution or any other company, body politic or corporate, or any individual, or to deceive any officer, auditor, examiner or agent of any such institution or of department or agency of the United States, makes any false entry in any book, report or statement of or to any such institution, or without being duly authorized, draws any order or bill of exchange, makes any acceptance, or issues, puts forth or assigns any note, debenture, bond or other obligation, or draft, bill of exchange, mortgage, judgment, or decree, or, with intent to defraud the United States or any agency thereof, or any corporation, institution, or association referred to in this section, participates or shares in or receives directly or indirectly any money, profit, property, or benefits through any transaction, loan, commission, contract, or any other act of any such corporation, institution, or association, shall be fined not more than $10.000 or imprisoned not more than five years, or both. (18 U. S. C. 1006)

Whoever knowingly makes any false statement or report, or willfully overvalues any land, property or security, for the purpose of influencing in any way the action of the Reconstruction Finance Corporation, Farm Credit Administration, Federal Crop Insurance Corporation, Farmers' Home Corporation, any Federal intermediate credit bank, or the Federal Farm Mortgage Corporation, or any division, officer, or employee thereof, or of any corporation organized under sections 1131–1134m of Title 12, or in which a Production Credit Corporation holds stock, or of any regional agricultural credit corporation established pursuant to law, or of the National Agricultural Credit Corporation, a Federal Home Loan Bank, the Federal Home Loan Bank Board, the Home Owners' Loan Corporation, a Federal Savings and Loan Association, a Federal land bank, a joint-stock land bank, a National farm loan association, or of a Federal Reserve Bank, upon any application, advance, discount, purchase, purchase agreement, repurchase agreement, commitment, or loan, or any change or extension of any of the same, by renewal, deferment of action or otherwise, or the acceptance, release, or substitution of security therefor, shall be fined not more than $5,000 or imprisoned not more than two years, or both. (18 U. S. C. 1014)

Whoever, while acting in any official capacity in the administration of any Act of Congress relating to crop insurance or to the Federal Crop Insurance Corporation speculates in any agricultural commodity or product thereof, to which such enactments apply, or in contracts relating thereto, or in the stock or membership interests of any association or corporation engaged in handling, processing, or disposing of any such commodity or product, shall be fined not more than $10,000 or imprisoned not more than two years, or both. (18 U. S. C. 1903)

SUGAR ACT OF 1948, AS AMENDED

EXPLANATORY NOTE

The first statute authorizing the imposition of sugar quotas on all areas supplying the United States market, including the mainland cane sugar area, the domestic beet sugar areas, and Hawaii, Puerto Rico, and the Virgin Islands, was the Jones-Costigan Sugar Act, approved in May 1934, which was an amendment to the Agricultural Adjustment Act of 1933. This act also authorized the Secretary to impose a processing tax on sugar and to enter into contracts with domestic growers providing for payments on a production limited to area quotas. In 1936 the production control and processing tax provisions of the Agricultural Adjustment Act were invalidated in the case of *United States* v. *Butler* (297 U. S. 1); however, sugar quotas were continued in effect and were subsequently revised and reenacted in the Sugar Act of 1937. The act of 1937 also provided for payments to producers of sugarcane and sugar beets who complied with specified conditions relating to child labor, farm wages, acreage allotments, soil conservation, and for payments to producers, who were also processors and who have paid to other producers fair prices for sugar beets or sugarcane.

The Sugar Act of 1948, enacted in August 1947, reenacted the Sugar Act of 1937 with certain changes, the most important of which related to the determination of the annual estimate of sugar consumption and the establishment of annual area sugar quotas. The constitutional validity of the quota provisions of the Sugar Act of 1948 has been upheld in the case of *Secretary of Agriculture* v. *Central Roig Refining Company et al.*, 338 U. S. 604. The act was amended in 1951 (65 Stat. 318), in 1956 (70 Stat. 217) and in 1958 (72 Stat. 950).

PART VI

SUGAR ACT OF 1948, AS AMENDED [1]

AN ACT

To regulate commerce among the several States, with the Territories and possessions of the United States, and with foreign countries; to protect the welfare of consumers of sugars and of those engaged in the domestic sugar-producing industry; to promote the export trade of the United States; and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Sugar Act of 1948." (7 U. S. C. 1100)

TITLE I—DEFINITIONS

SEC. 101. For the purpose of this Act, except title V—

(a) The term "person" means an individual, partnership, corporation, or association. (7 U. S. C. 1101 (a))

(b) The term "sugars" means any grade or type of saccharine product derived from sugarcane or sugar beets, which contains sucrose, dextrose, or levulose. (7 U. S. C. 1101 (b))

(c) The term "sugar" means raw sugar or direct-consumption sugar. (7 U. S. C. 1101 (c))

(d) The term "raw sugar" means any sugars (exclusive of liquid sugar from foreign countries having liquid sugar quotas), whether or not principally of crystalline structure, which are to be further refined or improved in quality to produce any sugars principally of crystalline structure or liquid sugar. (7 U. S. C. 1101 (d))

(e) The term "direct-consumption sugar" means any sugars principally of crystalline structure and any liquid sugar (exclusive of liquid sugar from foreign countries having liquid sugar quotas), which are not to be further refined or improved in quality. (7 U. S. C. 1101 (e))

(f) The term "liquid sugar" means any sugars (exclusive of sirup of cane juice produced from sugarcane grown in continental United States) which are principally not of crystalline structure and which contain, or which are to be used for the production of any sugars principally not of crystalline structure which contain soluble non-sugar solids (excluding any foreign substances that may have been added or developed in the product) equal to 6 per centum or less of the total soluble solids. (7 U. S. C. 1101 (f))

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[1] Approved August 8, 1947, 61 Stat. 922. The provisions of the Act are set forth as amended by the Act of September 1, 1951, 65 Stat. 318, and as further amended by the Act of May 29, 1956, 70 Stat. 217 and the Act of August 28, 1958, 72 Stat. 950. Sec. 22 of the Act of May 29, 1956 provides, "Except as otherwise provided, the amendments made hereby shall become effective as of January 1, 1956, except that sections 1 through 4 [amendments of paragraphs d, e, i, and n of section 101 of the Act] shall become effective upon publication in the Federal Register of regulations implementing such sections, or six months after the date of enactment of this Act, whichever is earlier." (7 U. S. C. 1101 note)

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(g) Sugars in dry amorphous form shall be considered to be principally of crystalline structure. (7 U. S. C. 1101 (g))

(h) The "raw value" of any quantity of sugars means its equivalent in terms of ordinary commercial raw sugar testing ninety-six sugar degrees by the polariscope, determined in accordance with regulations to be issued by the Secretary. The principal grades and types of sugar and liquid sugar shall be translated into terms of raw value in the following manner:

(1) For direct-consumption sugar, derived from sugar beets and testing ninety-two or more sugar degrees by the polariscope, by multiplying the number of pounds thereof by 1.07;

(2) For sugar, derived from sugarcane and testing ninety-two sugar degrees by the polariscope, by multiplying the number of pounds thereof by 0.93;

(3) For sugar, derived from sugarcane and testing more than ninety-two sugar degrees by the polariscope, by multiplying the number of pounds thereof by the figure obtained by adding to 0.93 the result of multiplying 0.0175 by the number of degrees and fractions of a degree of polarization above ninety-two degrees;

(4) For sugar and liquid sugar, testing less than ninety-two sugar degrees by the polariscope, by dividing the number of pounds of the "total sugar content" thereof by 0.972.

(5) The Secretary may establish rates for translating sugar and liquid sugar into terms of raw value for (a) any grade or type of sugar or liquid sugar not provided for in the foregoing and (b) any special grade or type of sugar or liquid sugar for which he determines that the raw value cannot be measured adequately under the provisions of paragraphs (1) to (4), inclusive, of this subsection (h). (7 U. S. C. 1101 (h))

(i) The term "total sugar content" means the sum of the sucrose and reducing or invert sugars contained in any grade or type of sugar or liquid sugar. (7 U. S. C. 1101 (i))

(j) The term "quota," depending upon the context, means (1) that quantity of sugar or liquid sugar which may be brought or imported into the continental United States, for consumption therein, during any calendar year, from the Territory of Hawaii, Puerto Rico, the Virgin Islands, or a foreign country or group of foreign countries; (2) that quantity of sugar or liquid sugar produced from sugar beets or sugarcane grown in the continental United States which, during any calendar year, may be shipped, transported, or marketed in interstate commerce, or in competition with sugar or liquid sugar shipped, transported, or marketed in interstate or foreign commerce; or (3) that quantity of sugar or liquid sugar which may be marketed in the Territory of Hawaii or in Puerto Rico, for consumption therein, during any calendar year. (7 U. S. C. 1101 (j))

(k) The term "producer" means a person who is the legal owner, at the time of harvest or abandonment, of a portion or all of a crop of sugar beets or sugarcane grown on a farm for the extraction of sugar or liquid sugar. (7 U. S. C. 1101 (k))

(l) The terms "including" and "include" shall not be deemed to exclude anything not mentioned but otherwise within the meaning of the term defined. (7 U. S. C. 1101 (l))

(m) The term "Secretary" means the Secretary of Agriculture. (7 U. S. C. 1101 (m))

(n) The term 'to be further refined or improved in quality' means to be subjected substantially to the processes of (1) affination or defecation, (2) clarification, and (3) further purification by adsorption or crystallization. The Secretary is authorized, after such hearing and upon such notice as he may by regulations prescribe, to determine whether specific processes to which sugars are subjected are sufficient to meet the requirements of this paragraph (n) and whether sugars of specific qualities are raw sugar within the meaning of paragraph (d) of this section, or direct-consumption sugar within the meaning of paragraph (e) of this section. (7 U. S. C. 1101 (n))

TITLE II—QUOTA PROVISIONS

ANNUAL ESTIMATE OF CONSUMPTION IN CONTINENTAL UNITED STATES

SEC. 201. The Secretary shall determine for each calendar year, beginning with the calendar year 1948, the amount of sugar needed to meet the requirements of consumers in the continental United States; such determinations shall be made during the month of December in each year for the succeeding calendar year (in the case of the calendar year 1948, during the first ten days thereof) and at such other times during such calendar year as the Secretary may deem necessary to meet such requirements. In making such determinations the Secretary shall use as a basis the quantity of direct-consumption sugar distributed for consumption, as indicated by official statistics of the Department of Agriculture, during the twelve-month period ending October 31 next preceding the calendar year for which the determination is being made, and shall make allowances for a deficiency or surplus in inventories of sugar, and for changes in consumption because of changes in population and demand conditions, as computed from statistics published by agencies of the Federal Government; and, in order that such determinations shall be made so as to protect the welfare of consumers and of those engaged in the domestic sugar industry by providing such supply of sugar as will be consumed at prices which will not be excessive to consumers and which will fairly and equitably maintain and protect the welfare of the domestic sugar industry, the Secretary, in making any such determination, in addition to the consumption, inventory, population, and demand factors above specified and the level and trend of consumer purchasing power, shall take into consideration the relationship between the prices at wholesale for refined sugar that would result from such determination and the general cost of living in the United States as compared with the relationship between prices at wholesale for refined sugar and the general cost of living in the United States obtaining during 1947–1949 as indicated by the Consumers' Price Index as published by the Bureau of Labor Statistics of the Department of Labor. (7 U. S. C. 1111)

PRORATION OF QUOTAS

SEC. 202. Whenever a determination is made, pursuant to section 201, of the amount of sugar needed to meet the requirements of con-

sumers, the Secretary shall establish quotas, or revise existing quotas—

(a) (1) For domestic sugar-producing areas by apportioning among such areas four million four hundred and forty-four thousand short tons, raw value, as follows:

Area	*Short tons raw value*
Domestic beet sugar	1,800,000
Mainland cane sugar	500,000
Hawaii	1,052,000
Puerto Rico	1,080,000
Virgin Islands	12,000

(2) To the above total of four million four hundred forty-four thousand short tons, raw value, there shall be added an amount equal to 55 per centum of the amount by which the Secretary's determination of requirements of consumers in the continental United States for the calendar year exceeds eight million three hundred and fifty thousand short tons, raw value. Such additional amount shall be apportioned among and added to the quotas established under paragraph (1) of this subsection for such domestic sugar-producing areas, respectively, as follows: (A) The first one hundred sixty-five thousand short tons, raw value, or any part thereof, by which quotas for the domestic areas are so increased shall be apportioned 51.5 per centum to the domestic beet sugar area and 48.5 per centum to the mainland cane sugar area; (B) the next twenty thousand short tons, raw value, or any part thereof, by which such quotas are so increased shall be apportioned to Puerto Rico; (C) the next three thousand short tons, raw value, or any part thereof, by which such quotas are so increased shall be apportioned to the Virgin Islands; (D) any additional amount shall be apportioned on the basis of the quotas established in paragraph (1) of this subsection as adjusted by subparagraphs (A), (B), and (C) of this paragraph (2). (7 U. S. C. 1112 (a))

(b) For the Republic of the Philippines, in the amount of nine hundred and fifty-two thousand short tons of sugar as specified in section 211 of the Philippine Trade Act of 1946. (7 U. S. C. 1112 (b))

(c) (1) For the calendar year 1956, for foreign countries other than the Republic of the Philippines, by prorating among such countries an amount of sugar, raw value, equal to the amount determined pursuant to section 201 less the sum of the quotas established pursuant to subsections (a) and (b) of this section, on the following basis:

Country	*Per centum*
Cuba	96
Foreign countries other than Cuba and the Republic of the Philippines	4

Ninety-five per centum of the quota for foreign countries other than Cuba and the Republic of the Philippines shall be prorated among such countries on the basis of the average amount imported from each such country within the quotas established for the years 1948, 1949, and 1950, except that a separate proration need not be established for any country which entered less than two per centum of the average importations within the quotas for such years. The amount of the quota not so prorated may be filled by countries not

receiving separate prorations, but no such country shall enter an amount pursuant to this subsection in excess of one per centum of the quota for foreign countries other than Cuba and the Republic of the Philippines.

(2) For the calendar year 1957 and for each subsequent calendar year, for foreign countries other than the Republic of the Philippines, (A) by prorating to Cuba 96 per centum and to other foreign countries 4 per centum of the amount of sugar, raw value, by which eight million three hundred and fifty thousand short tons, raw value, or such lesser amount as determined pursuant to section 201 exceeds the sum of four million four hundred and forty-four thousand short tons, raw value, and the quota established pursuant to subsection (b) of this section; and (B) by prorating 45 per centum of the amount of sugar, raw value, by which the amount determined pursuant to section 201 exceeds the sum of eight million three hundred and fifty thousand short tons, raw value, as follows:

Country	*Per centum*
Cuba	29.59
Peru	4.33
Dominican Republic	4.95
Mexico	5.10
Other countries	1.03
	45.00

The above proration of 1.03 per centum to foreign countries other than Cuba, the Republic of the Philippines, Peru, the Dominican Republic, and Mexico shall be apportioned to such other countries whose average entries within the quotas during 1953 and 1954 exceeded one thousand short tons, raw value, on the basis of the average entries within the quotas from each such country for the years 1951, 1952, 1953, and 1954.

(3) For the calendar year 1957 and for each subsequent calendar year, the proration of 4 per centum under paragraph (2) (A) of this subsection for foreign countries other than Cuba and the Republic of the Philippines shall be apportioned first, by assigning to each such foreign country whose average entries within the quotas during the years 1953 and 1954 were less than one thousand short tons, raw value, a proration equal to its average entries within the quotas during 1953 and 1954; second, by assigning to each such foreign country whose average entries within the quotas during 1953 and 1954 were not less than one thousand nor more than two thousand short tons, raw value, a proration of three thousand short tons, raw value; third, by assigning to each foreign country whose average entries within the quotas during 1953 and 1954 were more than two thousand and less than three thousand short tons, raw value, a proration equal to the average entries from each such country within the quotas during 1953 and 1954, plus two thousand short tons, raw value; fourth, by assigning to each foreign country whose average entries within the quotas during 1953 and 1954 were not less than three thousand nor more than ten thousand short tons, raw value, a proration equal to the average entries from each such country within the quotas during 1953 and 1954; and, fifth, by prorating the balance of such proration to such foreign countries whose average entries within the quotas during 1953 and 1954 exceeded ten thousand short

tons, raw value, on the basis of the average entries within the quotas from each such country for the years 1951, 1952, 1953, and 1954. (7 U. S. C. 1112 (c))

(d) Notwithstanding the other provisions of this title II, the minimum quota established for Cuba, including increases resulting from deficits determined pursuant to section 204 (a), shall not be less than the following:

(1) 28.6 per centum of the amount of sugar determined under section 201 when such amount is seven million four hundred thousand short tons or less; and

(2) two million one hundred and sixteen thousand short tons, when the amount of sugar determined under section 201 is more than seven million four hundred thousand short tons.

The quotas for domestic sugar-producing areas, established pursuant to the other provisions of this title II, shall be reduced pro rata by such amounts as may be required to establish such minimum quota for Cuba. (7 U. S. C. 1112 (d))

(e) Whenever in any year any foreign country with a quota or proration thereof of more than ten thousand short tons fails to fill such quota or proration by more than 10 per centum and at any time during such year the world price of sugar exceeds the domestic price, the quota or proration thereof for such country for subsequent years shall be reduced by an amount equal to the amount by which such country failed to fill its quota or proration thereof, unless the Secretary finds that such failure was due to crop disaster or force majeure or finds that such reduction would be contrary to the objectives of this Act. Any reduction hereunder shall be prorated in the same manner as deficits are prorated under section 204. (7 U. S. C. 1112 (e))

CONSUMPTION ESTIMATES AND QUOTAS FOR HAWAII AND PUERTO RICO

SEC. 203. In accordance with such provisions of section 201 as he deems applicable, the Secretary shall also determine the amount of sugar needed to meet the requirements of consumers in the Territory of Hawaii, and in Puerto Rico, and shall establish quotas for the amounts of sugar which may be marketed for local consumption in such areas equal to the amounts determined to be needed to meet the requirements of consumers therein. (7 U. S. C. 1113)

PRORATION OF QUOTA DEFICITS

SEC. 204. (a) The Secretary shall from time to time determine whether, in view of the current inventories of sugar, the estimated production from the acreage of sugarcane or sugar beets planted, the normal marketings within a calendar year of new-crop sugar, and other pertinent factors, any area will be unable to market the quota for such area. If the Secretary finds that any domestic area or Cuba will be unable to market the quota for such area, he shall revise the quotas for the domestic areas and Cuba by prorating an amount of sugar equal to the deficit so determined to the other such areas on the basis of the quotas then in effect: *Provided*, That any deficit in any domestic sugar-producing area occurring by reason of inability

to market that part of the quota for such area allotted under the provisions of section 202 (a) (2) shall first be prorated to other domestic areas on the basis of the quotas then in effect. If the Secretary finds that the Republic of the Philippines will be unable to market the quota for such area, he shall revise the quotas for Cuba and foreign countries other than Cuba and the Republic of the Philippines by prorating an amount of sugar equal to the deficit so determined, as follows:

To Cuba, 96 per centum; and

To foreign countries other than Cuba and the Republic of the Philippines, 4 per centum.

If the Secretary finds that foreign countries other than Cuba and the Republic of the Philippines cannot fill the quota for such area, he shall increase the quota for Cuba by an amount equal to the deficit.

Whenever the Secretary finds that any area will be unable to fill its proration of any such deficit, he may apportion such unfilled amount on such basis and to such areas as he determines is required to fill such deficit; except that in the case of proration of any such deficit in any domestic sugar-producing area occurring by reason of inability to market that part of the quota for such area allotted under and by reason of section 202 (a) (2), the Secretary shall apportion the unfilled amount on such basis and to such other domestic areas as he determines is required to fill such deficit, and if he finds that no domestic area will be able to supply such unfilled amount, he shall add it to the quota for Cuba. (7 U. S. C. 1114 (a))

(b) Whenever the Secretary finds that any country will be unable to fill the proration to such country of the quota for foreign countries other than Cuba and the Republic of the Philippines established under section 202 (c), or that any part of such proration has not been filled on September 1 of the calendar year, he may apportion such unfilled amount on such basis and to such countries as he determines is required to fill such proration. (7 U. S. C. 1114 (b))

(c) The quotas or applicable proration for any domestic area, the Republic of the Philippines, Cuba, or other foreign countries as established under the provisions of section 202 shall not be reduced by reason of any determination of a deficit existing in any calendar year under the provisions of subsections (a) and (b) of this section. (7 U. S. C. 1114 (c))

ALLOTMENTS OF QUOTAS OR PRORATIONS

SEC. 205. (a) Whenever the Secretary finds that the allotment of any quota, or proration thereof, established for any area pursuant to the provisions of this Act, is necessary to assure an orderly and adequate flow of sugar or liquid sugar in the channels of interstate or foreign commerce, or to prevent disorderly marketing or importation of sugar or liquid sugar, or to maintain a continuous and stable supply of sugar or liquid sugar, or to afford all interested persons an equitable opportunity to market sugar or liquid sugar within any area's quota, after such hearing and upon such notice as he may by regulations prescribe, he shall make allotments of such quota or proration thereof by alloting to persons who market or import sugar or

liquid sugar, for such periods as he may designate, the quantities of sugar or liquid sugar which each such person may market in continental United States, the Territory of Hawaii, or Puerto Rico, or may import or bring into continental United States, for consumption therein. Allotments shall be made in such manner and in such amounts as to provide a fair, efficient, and equitable distribution of such quota or proration thereof, by taking into consideration the processings of sugar or liquid sugar from sugar beets or sugarcane to which proportionate shares, determined pursuant to the provisions of subsection (b) of section 302, pertained; the past marketings or importations of each such person; and the ability of such person to market or import that portion of such quota or proration thereof allotted to him. In making such allotments, the Secretary may also take into consideration and make due allowance for the adverse effect of drought, storm, flood, freeze, disease, insects, or other similar abnormal and uncontrollable conditions seriously and broadly affecting any general area served by the factory or factories of such person. The Secretary may also, upon such hearing and notice as he may by regulations prescribe, revise or amend any such allotment upon the same basis as the initial allotment was made. (7 U. S. C. 1115 (a))

(b) An appeal may be taken, in the manner hereinafter provided from any decision making such allotments, or revisions thereof, to the United States Court of Appeals for the District of Columbia in any of the following cases:

(1) By any applicant for an allotment whose application shall have been denied.

(2) By any person aggrieved by reason of the Secretary granting or revising any allotment made to him. (7 U. S. C. 1115 (b))

(c) Such appeal shall be taken by filing with said court, within twenty days after the decision complained of is effective, notice in writing of said appeal and a statement of the reasons therefor, together with proof of service of a true copy of said notice and statement upon the Secretary. Unless a later date is specified by the Secretary as part of his decision, the decision complained of shall be considered to be effective as of the date on which public announcement of the decision is made at the office of the Secretary in the city of Washington. The Secretary shall thereupon, and in any event not later than ten days from the date of such service upon him, mail or otherwise deliver a copy of said notice of appeal to each person shown by the records of the Secretary to be interested in such appeal and to have a right to intervene therein under the provisions of this section, and shall at all times thereafter permit any such person to inspect and make copies of appellants' reasons for said appeal at the office of the Secretary in the city of Washington. *Within thirty days after the filing of said appeal the Secretary shall file with the court the record upon which the decision complained of was entered, as provided in section 2112 of title 28, United States Code, and a list of all interested persons to whom he has mailed or otherwise delivered a copy of said notice of appeal.*[2] (7 U. S. C. 1115 (c))

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[2] Material in italics substituted for the fourth sentence of subsection (c) by Pub. L. 85–791, 72 Stat. 950, August 28, 1958.

(d) Within thirty days after the filing of said appeal any interested person may intervene and participate in the proceedings had upon said appeal by filing with the court a notice of intention to intervene and a verified statement showing the nature of the interest of such party together with proof of service of true copies of said notice and statement, both upon the appellant and upon the Secretary. Any person who would be aggrieved or whose interests would be adversely affected by reversal or modification of the decision of the Secretary complained of shall be considered an interested party. (7 U. S. C. 1115 (d))

(e) At the earliest convenient time the court shall hear and determine the appeal upon the record before it, and shall have power, upon such record, to enter a judgment affirming or reversing the decision, and if it enters an order reversing the decision of the Secretary it shall remand the case to the Secretary to carry out the judgment of the court: *Provided, however*, That the review by the court shall be limited to questions of law and that findings of fact by the Secretary, if supported by substantial evidence, shall be conclusive unless it shall clearly appear that the findings of the Secretary are arbitrary or capricious. The court's judgment shall be final, subject, however, to review by the Supreme Court of the United States, upon writ of certiorari on petition therefor, under section 240 of the Judicial Code, as amended (U. S. C., title 28, sec. 1254), by appellant, by the Secretary, or by any interested party intervening in the appeal. (7 U. S. C. 1115 (e))

(f) The court may, in its discretion, enter judgment for costs in favor of or against an appellant, and other interested parties intervening in said appeal, but not against the Secretary, depending upon the nature of the issues involved in such appeal and the outcome thereof. (7 U. S. C. 1115 (f))

SEC. 206. Subject to the provisions of sections 207 and 408 relating to the suspension of quotas, sugar quotas shall be established pursuant to this Act for the calendar year 1948 within ten days after effective date of this Act. (7 U. S. C. 1116)

AMOUNT OF QUOTA TO BE FILLED BY DIRECT-CONSUMPTION SUGAR

SEC. 207. (a) Not more than twenty-nine thousand six hundred and sixteen short tons, raw value, of the quota for Hawaii for any calendar year, plus an amount equal to the same percentage of twenty-nine thousand six hundred and sixteen short tons, raw value, that the increase in the quota for Hawaii under section 202 is of one million fifty-two thousand short tons, raw value, may be filled by direct-consumption sugar. (7 U. S. C. 1117 (a))

(b) Not more than one hundred and twenty-six thousand and thirty-three short tons, raw value, of the quota for Puerto Rico for any calendar year may be filled by direct-consumption sugar which shall be principally of crystalline structure, plus an amount equal to the same percentage of one hundred twenty-six thousand and thirty-three short tons, raw value, that the increase in the quota for Puerto Rico under section 202 is of one million eighty thousand short tons, raw value, which latter amount may be filled by direct-consumption sugar whether or not principally of crystalline structure. (7 U. S. C. 1117 (b))

(c) None of the quota for the Virgin Islands for any calendar year may be filled by direct-consumption sugar. (7 U. S. C. 1117 (c))

(d) Not more than fifty-six thousand short tons of sugar of the quota for the Republic of the Philippines for any calendar year may be filled by direct-consumption sugar as specified in section 211 of the Philippine Trade Act of 1946. (7 U. S. C. 1117 (d))

(e) Not more than three hundred and seventy-five thousand short tons, raw value, of the quota for Cuba for any calendar year may be filled by direct-consumption sugar. (7 U. S. C. 1117 (e))

(f) This section shall not apply with respect to the quotas established under section 203 for marketing for local consumption in Hawaii and Puerto Rico. (7 U. S. C. 1117 (f))

(g) The direct-consumption portions of the quotas established pursuant to this section, and the enforcement provisions of title II applicable thereto, shall continue in effect and shall not be subject to suspension pursuant to the provisions of section 408 of this Act unless the President acting thereunder specifically finds and proclaims that a national economic or other emergency exists with respect to sugar or liquid sugar which requires the suspension of direct-consumption portions of the quotas. (7 U. S. C. 1117 (g)

(h) (1) For the calendar year 1956, the quota for foreign countries other than Cuba and the Republic of the Philippines may be filled by direct-consumption sugar only to the extent of 1.36 per centum of the amount of sugar determined pursuant to section 201 less the sum of the quotas established in subsections (a) and (b) of section 202: *Provided*, That each such country shall be permitted to enter an amount of direct-consumption sugar not less than the average amount entered by it during the years 1948, 1949, and 1950.

(2) For the calendar year 1957 and each subsequent calendar year, the quota for foreign countries other than Cuba and the Republic of the Philippines may be filled by direct-consumption sugar to the extent of 1.36 per centum of the amount of sugar determined pursuant to section 201 less the sum of the quotas established in subsections (a) and (b) of section 202: *Provided*, That such limitation shall not apply to countries receiving prorations under section 202 (c) of seven thousand short tons or less. The direct-consumption portion of such quota which is subject to the 1.36 per centum limitation referred to above shall be prorated to countries which receive prorations under section 202 (c) of more than seven thousand short tons on the basis of average imports of direct-consumption sugar within the quota for the years 1951, 1952, 1953, and 1954. (7 U. S. C. 1117 (h))

LIQUID SUGAR QUOTAS

SEC. 208. Quotas for liquid sugar for foreign countries for each calendar year are hereby established as follows:

Country	*In terms of wine gallons of 72 per centum total sugar content*
Cuba	7,970,558
Dominican Republic	830,894
British West Indies	300,000
Other foreign countries	0

(7 U. S. C. 1118)

PROHIBITED ACTS

SEC. 209. All persons are hereby prohibited—

(a) From bringing or importing into the continental United States from the Territory of Hawaii, Puerto Rico, the Virgin Islands, or foreign countries, (1) any sugar or liquid sugar after the applicable quota, or the proration of any such quota, has been filled, or (2) any direct-consumption sugar after the direct-consumption portion of any such quota has been filled; (7 U. S. C. 1119 (a))

(b) From shipping, transporting, or marketing in interstate commerce, or in competition with sugar or liquid sugar shipped, transported, or marketed in interstate or foreign commerce, any sugar or liquid sugar produced from sugar beets or sugarcane grown in either the domestic-beet-sugar area or the mainland cane-sugar area after the quota for such area has been filled; (7 U. S. C. 1119 (b))

(c) From marketing in either the Territory of Hawaii or Puerto Rico, for consumption therein, any sugar or liquid sugar after the quota therefor has been filled; (7 U. S. C. 1119 (c))

(d) From exceeding allotments of any quota, direct-consumption portion of any quota, or proration of any quota, made to them pursuant to the provisions of this Act. (7 U. S. C. 1119 (d))

SEC. 210. (a) The determinations provided for in sections 201 and 203, and all quotas, prorations, and allotments, except quotas established pursuant to the provisions of section 208, shall be made or established in terms of raw value. (7 U. S. C. 1120 (a))

(b) For the purposes of this title, liquid sugar, except that imported from foreign countries, shall be included with sugar in making the determinations provided for in sections 201 and 203 and in the establishment or revision of quotas, prorations, and allotments. (7 U. S. C. 1120 (b))

EXPORTATION OF SUGAR

SEC. 211. (a) The raw-value equivalent of any sugar or liquid sugar in any form, including sugar or liquid sugar in manufactured products, exported from the continental United States under the provisions of section 313 of the Tariff Act of 1930 shall be credited against any charges which shall have been made in respect to the applicable quota or proration for the country of origin. The country of origin of sugar or liquid sugar in respect to which any credit shall be established shall be that country in respect to importation from which draw-back of the exported sugar or liquid sugar has been claimed. Sugar or liquid sugar entered into the continental United States under an applicable bond established pursuant to orders or regulations issued by the Secretary, for the express purpose of subsequently exporting the equivalent quantity of sugar or liquid sugar as such, or in manufactured articles, shall not be charged against the applicable quota or proration for the country of origin. (7 U. S. C. 1121 (a))

(b) Exportation within the meaning of sections 309 and 313 of the Tariff Act of 1930 shall be considered to be exportation within the meaning of this section. (7 U. S. C. 1121 (b))

(c) The quota established for any domestic sugar-producing area may be filled only with sugar or liquid sugar produced from sugar

beets or sugarcane grown in such area: *Provided, however*, That any sugar or liquid sugar admitted free of duty from the Virgin Islands under the Act of Congress, approved March 3, 1917 (39 Stat. 1133), may be admitted within the quota for the Virgin Islands. (7 U. S. C. 1121 (c))

INAPPLICABILITY OF QUOTA PROVISIONS

SEC. 212. The provisions of this title shall not apply to (1) the first ten short tons, raw value, of sugar or liquid sugar imported from any foreign country, other than Cuba and the Republic of the Philippines, in any calendar year; (2) the first ten short tons, raw value, of sugar or liquid sugar imported from any foreign country, other than Cuba and the Republic of the Philippines, in any calendar year for religious, sacramental, educational, or experimental purposes; (3) liquid sugar imported from any foreign country, other than Cuba and the Republic of the Philippines, in individual sealed containers of such capacity as the Secretary may determine, not in excess of one and one-tenth gallons each; or (4) any sugar or liquid sugar imported, brought into, or produced or manufactured in the United States for the distillation of alcohol, or for livestock feed, or for the production of livestock feed. (7 U. S. C. 1122)

TITLE III—CONDITIONAL PAYMENT PROVISIONS

CONDITIONS OF PAYMENT

SEC. 301. The Secretary is authorized to make payments on the following conditions with respect to sugar or liquid sugar commercially recoverable from the sugar beets or sugarcane grown on a farm for the extraction of sugar or liquid sugar:

(a) That no child under the age of fourteen years shall have been employed or permitted to work on the farm, whether for gain to such child or any other person, in the production, cultivation, or harvesting of a crop of sugar beets or sugarcane with respect to which applications for payment is made, except a member of the immediate family of a person who was the legal owner of not less than 40 per centum of the crop at the time such work was performed; and that no child between the ages of fourteen and sixteen years shall have been employed or permitted to do such work, whether for gain to such child or any other person, for a longer period than eight hours in any one day, except a member of the immediate family of a person who was the legal owner of not less than 40 per centum of the crop at the time such work was performed. The Secretary is authorized to make payments, notwithstanding a failure to comply with the conditions provided in this subsection, but the payments made with respect to any crop shall be subject to a deduction of $10 for each child for each day, or a portion of a day, during which such child was employed or permitted to work contrary to the foregoing provisions of this subsection. (7 U. S. C. 1131 (a))

(b) That there shall not have been marketed (or processed), except for livestock feed, or for the production of livestock feed, as determined by the Secretary, an amount (in terms of planted acre-

age, weight, or recoverable sugar content) of sugar beets or sugarcane grown on the farm and used for the production of sugar or liquid sugar to be marketed in, or so as to compete with or otherwise directly affect interstate or foreign commerce, in excess of the proportionate share for the farm, as determined by the Secretary pursuant to the provisions of section 302, of the total quantity of sugar beets or sugarcane required to be processed to enable the area in which such sugar beets or sugarcane are produced to meet the quota (and provide a normal carry-over inventory) as estimated by the Secretary for such area for the calendar year during which the larger part of the sugar or liquid sugar from such crop normally would be marketed. (7 U. S. 1131 (b))

(c) (1) That all persons employed on the farm in the production, cultivation, or harvesting of sugar beets or sugarcane with respect to which an application for payment is made shall have been paid in full for all such work, and shall have been paid wages therefor at rates not less than those that may be determined by the Secretary to be fair and reasonable after investigation and due notice and opportunity for public hearing; and in making such determinations the Secretary shall take into consideration the standards therefor formerly established by him under the Agricultural Adjustment Act, as amended, and the differences in conditions among various producing areas: *Provided, however*, That a payment which would be payable except for the foregoing provisions of this subparagraph may be made, as the Secretary may determine, in such manner that the laborer will receive an amount, insofar as such payment will suffice, equal to the amount of the accrued unpaid wages for such work, and that the producer will receive the remainder, if any, of such payment.

(2) That the producer on the farm who is also, directly or indirectly a processor of sugar beets or sugarcane, as may be determined by the Secretary shall have paid, or contracted to pay under either purchase or toll agreements, for any sugar beets or sugarcane grown by other producers and processed by him at rates not less than those that may be determined by the Secretary to be fair and reasonable after investigation and due notice and opportunity for public hearing. (7 U. S. 1131 (c))

ESTABLISHMENT OF PROPORTIONATE SHARES FOR FARMS

SEC. 302. (a) The amount of sugar or liquid sugar with respect to which payment may be made shall be the amount of sugar or liquid sugar commercially recoverable, as determined by the Secretary, from the sugar beets or sugarcane grown on the farm and marketed (or processed by the producer) not in excess of the proportionate share for the farm, as determined by the Secretary, of the quantity of sugar beets or sugarcane for the extraction of sugar or liquid sugar required to be processed to enable the producing area in which the crop of sugar beets or sugarcane is grown to meet the quota (and provide a normal carry-over inventory) estimated by the Secretary for such area for the calendar year during which the larger part of the sugar or liquid sugar from such crop normally would be marketed. (7 U. S. C. 1132 (a))

(b) In determining the proportionate shares with respect to a farm, the Secretary may take into consideration the past production on the farm of sugar beets and sugarcane marketed (or processed) within the proportionate share for the extraction of sugar or liquid sugar and the ability to produce such sugar beets or sugarcane, and the Secretary shall, insofar as practicable, protect the interests of new producers and small producers and the interests of producers who are cash tenants, share tenants, adherent planters, or share croppers and of the producers in any local producing area whose past production has been adversely, seriously, and generally affected by drought, storm, flood, freeze, disease, insects, or other similar abnormal and uncontrollable conditions. For the purposes of establishing proportionate shares hereunder and in order to encourage wise use of land resources, foster greater diversification of agricultural production, and promote the conservation of soil and water resources in Puerto Rico, the Secretary, on application of any owner of a farm in Puerto Rico, is hereby authorized, whenever he determines it to be in the public interest and to facilitate the sale or rental of land for other productive purposes, to transfer the sugarcane production record for any parcel or parcels of land in Puerto Rico owned by the applicant to any other parcel or parcels of land owned by such applicant in Puerto Rico. (7 U. S. C. 1132 (b))

(c) Payments shall be effective with respect to sugar or liquid sugar commercially recoverable from sugar beets and sugarcane grown on a farm commencing with the crop year 1948. (7 U. S. C. 1132 (c))

ACREAGE ABANDONMENT AND CROP DEFICIENCY PAYMENTS

SEC. 303. In addition to the amount of sugar or liquid sugar with respect to which payments are authorized under subsection (a) of section 302, the Secretary is also authorized to make payments, on the conditions provided in section 301, with respect to bona fide abandonment of planted acreage and crop deficiencies of harvested acreage, resulting from drought, flood, storm, freeze, disease, or insects, which cause such damage to all or a substantial part of the crop of sugar beets or sugarcane in the same factory district (as established by the Secretary), county, parish, municipality, or local producing area, as determined in accordance with regulations issued by the Secretary, on the following quantities of sugar or liquid sugar: (1) With respect to such bona fide abandonment of each planted acre of sugar beets or sugarcane, one-third of the normal yield of commercially recoverable sugar or liquid sugar per acre for the farm, as determined by the Secretary; and (2) with respect to such crop deficiencies of harvested acreage of sugar beets or sugarcane, the excess of 80 per centum of the normal yield of commercially recoverable sugar or liquid sugar for such acreage for the farm, as determined by the Secretary, over the actual yield. (7 U. S. C. 1133)

COMPUTATION OF PAYMENTS AND PERSONS ELIGIBLE FOR PAYMENTS

SEC. 304. (a) The amount of the base rate of payment shall be 80 cents per hundred pounds of sugar or liquid sugar, raw value. (7 U. S. C. 1134 (a))

(b) All payments shall be calculated with respect to farm which, for the purposes of this Act, shall be a farming unit as determined in accordance with regulations issued by the Secretary, and in making such determinations, the Secretary shall take into consideration the use of common work stock, equipment, labor, management, and other pertinent factors. (7 U. S. C. 1134 (b))

(c) The total payment with respect to a farm shall be the product of the base rate specified in subsection (a) of this section multiplied by the amount of sugar and liquid sugar, raw value, with respect to which payment is to be made, except that reduction shall be made from such total payment in accordance with the following scale of reductions:

That portion of the quantity of sugar and liquid sugar which is included within the following intervals of short tons, raw value:

	Reduction in the basic rate of payment per hundredweight of such portion
350 to 700	$0.05
700 to 1,000	.10
1,000 to 1,500	.20
1,500 to 3,000	.25
3,000 to 6,000	.275
6,000 to 12,000	.30
12,000 to 30,000	.325
More than 30,000	.50

(7 U. S. C. 1134 (c))

(d) Application for payment shall be made by, and payments shall be made to, the producer or, in the event of his death, disappearance, or incompetency, his legal representative, or heirs: *Provided, however*, That all producers on the farm shall signify in the application for payment the percentage of the total payment with respect to the farm to be made to each producer: *And provided further*, That payments may be made, (1) in the event of the death, disappearance, or incompetency of a producer, to such beneficiary as the producer may designate in the application for payment; (2) to one producer of a group of two or more producers, provided all producers on the farm designate such producer in the application for payment as sole recipient for their benefit of the payment with respect to the farm; or (3) to a person who is not a producer, provided such person controls the land included within the farm with respect to which the application for payment is made and is designated by the sole producer (or all producers) on the farm, as sole recipient for his or their benefit, of the payment with respect to the farm. (7 U. S. C. 1134 (d))

USE OF LOCAL COMMITTEES AND OTHER AGENCIES

SEC. 305. In carrying out the provisions of titles II and III of this Act, the Secretary is authorized to utilize local committees of sugar beet or sugarcane producers, State and county agricultural conservation committees, or the Agricultural Extension Service and other agencies, and the Secretary may prescribe that all or a part of the expenses of such committees may be deducted from the payments herein authorized. (7 U. S. C. 1135)

FINALITY OF DETERMINATIONS

SEC. 306. The facts constituting the basis for any payment, or the amount thereof authorized to be made under this title, officially determined in conformity with rules or regulations prescribed by the Secretary, shall be reviewable only by the Secretary, and his determinations with respect thereto shall be final and conclusive. (7 U. S. C. 1136)

APPLICABILITY OF TITLE III

SEC. 307. This title shall apply to the continental United States, the Territory of Hawaii, Puerto Rico, and the Virgin Islands. (7 U. S. C. 1137)

TITLE IV—GENERAL PROVISIONS

EXPENDITURES BY SECRETARY

SEC. 401. For the purposes of this Act, the Secretary may make such expenditures as he deems necessary to carry out the provisions of this Act, including personal services and rents in the District of Columbia and elsewhere. (7 U. S. C. 1151)

APPROPRIATIONS AND AVAILABILITY OF FUNDS

SEC. 402. (a) There is hereby authorized to be appropriated for each fiscal year for the purposes and administration of this Act the funds necessary to make the payments provided for in title III of this Act and such other amounts as the Congress determines to be necessary for such fiscal year to carry out the other provisions of the Act. (7 U. S. C. 1152 (a))

(b) All funds available for carrying out this Act shall be available for allotment to the bureaus and offices of the Department of Agriculture and for transfer to such other agencies of the Federal Government as the Secretary may request to cooperate or assist in carrying out the provisions of this act. (7 U. S. C. 1152 (b))

(c) The funds made available for the purpose of enabling the Secretary to carry into effect the provisions of the Sugar Act of 1937, as amended, during the fiscal year 1948 are also hereby made available to the Secretary for purposes of administration of the provisions of this Act during the fiscal year 1948. (7 U. S. C. 1152 (c))

REGULATIONS AND DETERMINATIONS

SEC. 403. (a) The Secretary is authorized to make such orders or regulations, which shall have the force and effect of law, as may be necessary to carry out the powers vested in him by this Act. Any person knowingly violating any order or regulation of the Secretary issued pursuant to this Act shall, upon conviction, be punished by a fine or not more than $100 for each such violation. (7 U. S. C. 1153 (a))

(b) Each determination issued by the Secretary in connection with quotas and deficits under title II or payments under title III of this Act shall be promptly published in the Federal Register and

shall be accompanied by a statement of the bases and considerations upon which such determination was made. (7 U. S. C. 1153 (b))

JURISDICTION OF COURTS

SEC. 404. The several district courts of the United States are hereby vested with jurisdiction specifically to enforce, and to prevent and restrain any person from violating, the provisions of this Act or of any order or regulation made or issued pursuant to this Act. If and when the Secretary shall so request, it shall be the duty of the several district attorneys of the United States, in their respective districts, to institute proceedings to enforce the remedies and to collect the penalties and forfeitures provided for in this Act. The remedies provided for in this Act shall be in addition to, and not exclusive of, any of the remedies or penalties existing at law or in equity. (7 U. S. C. 1154)

CIVIL PENALTIES

SEC. 405. (a) Any person who knowingly violates, or attempts to violate, or who knowingly participates or aids in the violation of, any of the provisions of section 209, or any person who brings or imports into the continental United States direct-consumption sugar after the quantities specified in section 207 have been filled, shall forfeit to the United States the sum equal to three times the market value, at the time of the commission of any such act, (1) of that quantity of sugar or liquid sugar by which any quota, proration, or allotment is exceeded, or (2) of that quantity brought or imported into the continental United States after the quantities specified in section 207 have been filled, which forfeiture shall be recoverable in a civil suit brought in the name of the United States. (7 U. S. C. 1155 (a))

(b) Any person whose sugar processing operations otherwise meet the requirements of section 101 (n) and who subjects to such processes sugar imported or brought into the continental United States under a declaration that it is raw sugar but which sugar subsequently is determined to be of direct-consumption quality, shall forfeit to the United States a sum equal to 1 cent per pound for each pound, raw value, of such sugar in excess of that part of the direct-consumption portion of the applicable quota or proration or allotment thereof remaining unfilled at the time of such determination, which forfeiture shall be recoverable in a civil suit brought in the name of the United States. (7 U. S. C. 1155 (b))

FURNISHING INFORMATION TO SECRETARY

SEC. 406. All persons engaged in the manufacturing, marketing, or transportation or industrial use of sugar or liquid sugar, and having information which the Secretary deems necessary to enable him to administer the provisions of this Act, shall, upon the request of the Secretary, furnish him with such information. Any person willfully failing or refusing to furnish such information or furnishing willfully any false information, shall upon conviction be subject

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to a penalty of not more than $1,000 for each such violation. (7 U. S. C. 1156)

SUGAR INVESTMENTS BY OFFICIALS PROHIBITED

SEC. 407. No person shall, while acting in any official capacity in the administration of this Act, invest or speculate in sugar or liquid sugar, contracts relating thereto, or the stock or membership interests of any association or corporation engaged in the production or manufacturing of sugar or liquid sugar. Any person violating this section shall upon conviction thereof be fined not more than $10,000 or imprisoned not more than two years, or both. The provisions of this section shall not apply to persons whose services are obtained pursuant to section 305. (7 U. S. C. 1157)

SUSPENSION OF QUOTAS

SEC. 408. Whenever pursuant to the provisions of this Act the President finds and proclaims that a national economic or other emergency exists with respect to sugar or liquid sugar, he shall by proclamation suspend the operation, except as provided in section 207 of this Act, of all the provisions of title II above, and, thereafter, the operation of such title shall continue in suspense until the President finds and proclaims that the facts which occasioned such suspension no longer exist. The Secretary shall make such investigations and reports thereon to the President as may be necessary to aid him in carrying out the provisions of this section. (7 U. S. C. 1158)

SURVEYS AND INVESTIGATIONS

SEC. 409. Whenever the Secretary determines that such action is necessary to effectuate the purposes of this Act, he is authorized, if first requested by persons constituting or representing a substantial proportion of the persons affected in any one of the five domestic sugar-producing areas, to make for such area surveys and investigations to the extent he deems necessary, including the holding of public hearings, and to make recommendations with respect to (a) the terms and conditions of contracts between the producers and processors of sugar beets and sugarcane in such area and (b) the terms and conditions of contracts between laborers and producers of sugar beets and sugarcane in such area. In carrying out the provisions of this section, information shall not be made public with respect to the individual operations of any processor, producer, or laborer. (7 U. S. C. 1159)

SEC. 410. The Secretary is authorized to conduct surveys, investigations and research relating to the conditions and factors affecting the methods of accomplishing most effectively the purposes of this Act and for the benefit of agriculture generally in any area. Notwithstanding any provision of existing law, the Secretary is authorized to make public such information as he deems necessary to carry out the provisions of this Act. (7 U. S. C. 1160)

SEC. 411. The Secretary is authorized to issue such regulations as may be necessary to carry out article 7 of the International Sugar Agreement for the Regulation of the Production and Marketing of

Sugar (ratified by and with the advice and consent of the United States Senate on April 29, 1954), restricting importations of sugar into the United States from foreign countries not participating in such agreement, or to carry out the corresponding provisions of any such future agreements ratified by and with the advice and consent of the United States Senate. (7 U. S. C. 1161)

TERMINATION OF ACT

SEC. 412. The powers vested in the Secretary under this Act shall terminate on December 31, 1960, except that the Secretary shall have power to make payments under title III under programs applicable to the crop year 1960 and previous crop years. (7 U. S. C. 1101, Note)

EFFECTIVE DATE

SEC. 413. The provisions of this Act, except where an earlier effective date is provided for herein, shall become effective January 1, 1948. As provided in section 513 of the Sugar Act of 1937, the powers vested in the Secretary under that Act shall terminate on December 31, 1947, except that the Secretary shall have power to make payments under title III of that Act under programs thereunder applicable to the crop year 1947 and previous crop years. (7 U. S. C. 1101, Note)

EXCISE TAXES WITH RESPECT TO SUGAR[3]

INTERNAL REVENUE CODE OF 1954

CHAPTER 37

Subchapter A—Sugar

SEC. 4501. IMPOSITION OF TAX.

(a) GENERAL.—There is hereby imposed upon manufactured sugar manufactured in the United States, a tax, to be paid by the manufacturer at the following rates:

(1) on all manufactured sugar testing by the polariscope 92 sugar degrees, 0.465 cent per pound, and, for each additional sugar degree shown by the polariscopic test, 0.00875 cent per pound additional, and fractions of a degree in proportion;

(2) on all manufactured sugar testing by the polariscope less than 92 sugar degrees, 0.5144 cent per pound of the total sugars therein.

The manufacturer shall pay the tax with respect to manufactured sugar (1) which has been sold, or used in the production of other articles, by the manufacturer during the preceding month (if the tax has not already been paid) and (2) which has not been so sold or used within 12 months ending during the preceding calendar month, after it was manufactured (if the tax has not already been paid).

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[3] Only those provisions of the Internal Revenue Code of 1954 which became effective January 1, 1955, and subsequent amendments which deal directly with sugar are included. See title 26 of the United States Code for general definitions, time and place for filing returns and paying taxes, interest, abatements, credits, refunds, etc.

For the purpose of determining whether sugar has been sold or used within 12 months after it was manufactured, sugar shall be considered to have been sold or used in the order in which it was manufactured. (26 U. S. C. 4501 (a))

(b) IMPORT TAX.—In addition to any other tax or duty imposed by law, there is hereby imposed, under such regulations as the Secretary or his delegate shall prescribe, a tax upon articles imported or brought into the United States as follows:

(1) on all manufactured sugar testing by the polariscope 92 sugar degrees, 0.465 cent per pound, and, for each additional sugar degree shown by the polariscopic test, 0.00875 cent per pound additional, and fractions of a degree in proportion;

(2) on all manufactured sugar testing by the polariscope less than 92 sugar degrees, 0.5144 cent per pound of the total sugars therein;

(3) on all articles composed in chief value of manufactured sugar, 0.5144 cent per pound of the total sugars therein. (26 U. S. C. 4501 (b))

(c) TERMINATION OF TAX.—No tax shall be imposed under this subchapter on the manufacture, use, or importation of sugar or articles composed in chief value of sugar after June 30, 1961. Notwithstanding the provisions of subsection (a) or (b), no tax shall be imposed under this subchapter with respect to unsold sugar held by manufacturer on June 30, 1961, or with respect to sugar or articles composed in chief value of sugar held in customs custody or control on such date. With respect to any sugar or articles composed in chief value of sugar upon which tax imposed under subsection (b) has been paid and which, on June 30, 1961, are held by the importer and intended for sale or other disposition, there shall be refunded (without interest) to such importer, subject to such regulations as may be prescribed by the Secretary or his delegate, an amount equal to the tax paid with respect to such sugar or articles composed in chief value of sugar. (26 U. S. C. 4501 (c))

SEC. 4502. DEFINITIONS.

For the purposes of this subchapter—

(1) MANUFACTURER.—Any person who acquires any sugar which is to be manufactured into manufactured sugar but who, without further refining or otherwise improving it in quality, sells such sugar as manufactured sugar or uses such sugar as manufactured sugar in the production of other articles for sale shall be considered, for the purposes of section 4501 (a), the manufacturer of manufactured sugar and, as such, liable for the tax under section 4501 (a) with respect thereto.

(2) PERSON.—The term "person" means an individual partnership, corporation, or association.

(3) MANUFACTURED SUGAR.—The term "manufactured sugar" means any sugar derived from sugar beets or sugarcane, which is not to be, and which shall not be, further refined or otherwise improved in quality; except sugar in liquid form which contains nonsugar solids (excluding any foreign substance that may have been added or developed in the product) equal to more than 6 per centum of the total soluble solids and except also sirup of cane juice produced from sugarcane grown in continental United

States. The grades or types of sugar within the meaning of this definition shall include, but shall not be limited to, granulated sugar, lump sugar, cube sugar, powdered sugar, sugar in the form of blocks, cones, or molded shapes, confectioners' sugar, washed sugar, centrifugal sugar, clarified sugar, turbinado sugar, plantation white sugar, muscovado sugar, refiners' soft sugar, invert sugar mush, raw sugar, sirups, molasses, and sugar mixtures.

(4) TOTAL SUGARS.—The term "total sugars" means the total amount of the sucrose and of the reducing or invert sugars.

(5) UNITED STATES.—The term "United States" shall be deemed to include the States, the Territories of Hawaii and Alaska, the District of Columbia, and Puerto Rico. (26 U. S. C. 4502)

SEC. 4503. EXEMPTIONS FOR SUGAR MANUFACTURED FOR HOME CONSUMPTION.

No tax shall be required to be paid under sec. 4501 (a) upon the manufacture of manufactured sugar by or for the producer of the sugar beets or sugarcane from which such manufactured sugar was derived, for consumption by the producer's own family, employees, or household. (26 U. S. C. 4503)

SEC. 4504. IMPORT TAX IMPOSED AS TARIFF DUTY.

The tax imposed by section 4501 (b) shall be levied, assessed, collected, and paid in the same manner as a duty imposed by the Tariff Act of 1930 (46 Stat. 590; 19 U. S. C., chapter 4) and shall be treated for the purposes of all provisions of law relating to the customs revenue as a duty imposed by such act, except that for the purposes of sections 336 and 350 of such act (the so-called flexible tariff and trade agreements provisions; 46 Stat. 701; 48 Stat. 943; 19 U. S. C. 1336, 1351) such tax shall not be considered a duty or import restriction, and except that no preference with respect to such tax shall be accorded any articles imported or brought into the United States, and except that such tax may be subject to refunds as a tax under the provisions of section 6418 (a). (26 U. S. C. 4504)

CHAPTER 65—ABATEMENTS, CREDITS, AND REFUNDS

SEC. 6412. FLOOR STOCKS REFUNDS.

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(d) SUGAR.—With respect to any sugar or articles composed in chief value of sugar upon which tax imposed under section 4501 (b) has been paid and which, on June 30, 1961, are held by the importer and intended for sale or other disposition, there shall be refunded (without interest) to such importer, subject to such regulations as may be prescribed by the Secretary or his delegate, an amount equal to the tax paid with respect to such sugar or articles composed in chief value of sugar. (26 U. S. C. 6412 (d))

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SEC. 6418. SUGAR.

(a) USE AS LIVESTOCK FEED OR FOR DISTILLATION OF ALCOHOL.—Upon the use of any manufactured sugar, or article manufactured therefrom, as livestock feed, or in the production of livestock feed,

or for the distillation of alcohol, there shall be paid by the Secretary or his delegate to the person so using such manufactured sugar, or article manufactured therefrom, the amount of any tax paid under section 4501 with respect thereto. (26 U. S. C. 6418 (a))

(b) EXPORTATION.—Upon the exportation from the United States to a foreign country, or the shipment from the United States to any possession of the United States except Puerto Rico, of any manufactured sugar, or any article manufactured wholly or partly from manufactured sugar, with respect to which tax under the provisions of section 4501 (a) has been paid, the amount of such tax shall be paid by the Secretary or his delegate to the consignor named in the bill of lading under which the article was exported or shipped to a possession, or to the shipper, or to the manufacturer of the manufactured sugar or of the articles exported, if the consignor waives any claim thereto in favor of such shipper or manufacturer; except that no such payment shall be allowed with respect to any manufactured sugar, or article, upon which, through substitution or otherwise, a drawback of any tax paid under section 4501 (b) has been or is to be claimed under any provisions of law made applicable by section 4504. (26 U. S. C. 6418 (b))

CHAPTER 66—LIMITATIONS

SEC. 6511. LIMITATIONS ON CREDIT OR REFUND.

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(e) SPECIAL RULES IN CASE OF MANUFACTURED SUGAR.—

(1) USE AS LIVESTOCK FEED OR FOR DISTILLATION OF ALCOHOL.—No payment shall be allowed under section 6418 (a) unless within 2 years after the right to such payment has accrued a claim therefor is filed by the person entitled thereto.

(2) EXPORTATION.—No payment shall be allowed under section 6418 (b) unless within 2 years after the right to such payment has accrued a claim therefor is filed by the person entitled thereto. (26 U. S. C. 6511 (e))

CHAPTER 75—CRIMES, OTHER OFFENSES, AND FORFEITURES

SEC. 7240. OFFICIALS INVESTING OR SPECULATING IN SUGAR.

Any person, while acting in an official capacity in the administration of subchapter A of chapter 37, relating to manufactured sugar, who invests or speculates in sugar or liquid sugar, contracts relating thereto, or the stock or membership interests of any association or corporation engaged in the production or manufacture of sugar or liquid sugar, shall be dismissed from office or discharged from employment and shall be guilty of a felony and, upon conviction thereof, be fined not more than $10,000, or imprisoned not more than 2 years, or both. (26 U. S. C. 7240)

PART VII

MISCELLANEOUS LAWS

EXPLANATORY NOTE

Included in this part of the compilation are certain miscellaneous laws which govern or affect certain programs and functions of several agencies of the Department of Agriculture.

The Agricultural Marketing Agreement Act of 1937 reenacted and amended certain provisions of the Agricultural Adjustment Act (of 1933), as amended, which related to marketing agreements and orders, and which contained section 22 authorizing the imposition of quotas and fees on agricultural commodities imported into the United States.

The National School Lunch Act provides for distribution of commodities to schools for utilization in the school-lunch program.

The Act of December 20, 1944, authorizes the Secretary of Agriculture to compromise, adjust, or cancel certain debts of farmers to the United States.

AGRICULTURAL MARKETING AGREEMENT ACT OF 1937,[1] REENACTING, AMENDING, AND SUPPLEMENTING THE AGRICULTURAL ADJUSTMENT ACT, AS AMENDED

AN ACT

To reenact and amend provisions of the Agricultural Adjustment Act, as amended, relating to marketing agreements and orders.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following provisions of the Agricultural Adjustment Act, as amended, not having been intended for the control of the production of agricultural commodities, and having been intended to be effective irrespective of the validity of any other provision of that Act are expressly affirmed and validated, and are reenacted without change except as provided in section 2:

(a) Section 1 (relating to the declaration of emergency);

DECLARATION

[It is hereby declared that the disruption of the orderly exchange of commodities in interstate commerce impairs the purchasing power

[1] Approved June 3, 1937, 50 Stat. 246. This Act reenacted and amended certain provisions of title I of the Agricultural Adjustment Act (of 1933), as amended. The provisions which were reenacted (with all amendments up to this time) are set out in sec. 1 in brackets after the appropriate subsections. Amendments made by the Agricultural Act of 1948 and subsequent legislation are noted below. Wherever reference is made to "this title" in these provisions, the reference is to title I of the 1933 Act.

of farmers and destroys the value of agricultural assets which support the national credit structure and that these conditions affect transactions in agricultural commodities with a national public interest, and burden and obstruct the normal channels of interstate commerce. (7 U. S. C. 601)]

(b) Section 2 (relating to declaration of policy);

DECLARATION OF POLICY

[SEC. 2. It is hereby declared to be the policy of Congress—

(1) Through the exercise of the powers conferred upon the Secretary of Agriculture under this title, to establish and maintain such orderly marketing conditions for agricultural commodities in interstate commerce as will establish, as the prices to farmers, parity prices as defined by section 301 (a) (1) of the Agricultural Adjustment Act of 1938.[2]

(2) To protect the interest of the consumer by (a) approaching the level of prices which it is declared to be the policy of Congress to establish in subsection (1) of this section by gradual correction of the current level at as rapid a rate as the Secretary of Agriculture deems to be in the public interest and feasible in view of the current consumptive demand in domestic and foreign markets, and (b) authorizing no action under this title which has for its purpose the maintenance of prices to farmers above the level which it is declared to be the policy of Congress to establish in subsection (1) of this section.

(3) Through the exercise of the power conferred upon the Secretary of Agriculture under this title, to establish and maintain such minimum standards of quality and maturity and such grading and inspection requirements for agricultural commodities enumerated in section 8c (2), other than milk and its products, in interstate commerce as will effectuate such orderly marketing of such agricultural commodities as will be in the public interest.

(4) Through the exercise of the power conferred upon the Secretary of Agriculture under this title, to establish and maintain such orderly marketing conditions for any agricultural commodity enumerated in section 8c (2) as will provide, in the interests of producers and consumers, an orderly flow of the supply thereof to market throughout its normal marketing season to avoid unreasonable fluctuations in supplies and prices. (7 U. S. C. 602)][3]

(c) Section 8a (5), (6), (7), (8), and (9) (relating to violations and enforcement);

VIOLATIONS AND ENFORCEMENT

[SEC. 8a (5) Any person willfully exceeding any quota or allotment fixed for him under this title by the Secretary of Agriculture, and any other person knowingly participating, or aiding, in the exceeding of said quota or allotment, shall forfeit to the United States a sum equal to three times the current market value of such

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[2] Amended by sec. 302 of the Agricultural Act of 1948 (July 3, 1948, 62 Stat. 1247) to refer to parity prices as defined in the Agricultural Adjustment Act of 1938.

[3] Subsec. (4) added by sec. 401 of the Agricultural Act of 1954.

excess, which forfeiture shall be recoverable in a civil suit brought in the name of the United States.

(6) The several district courts of the United States are hereby vested with jurisdiction specifically to enforce, and to prevent and restrain any person from violating any order, regulation, or agreement, heretofore or hereafter made or issued pursuant to this title, in any proceeding now pending or hereafter brought in said courts.

(7) Upon the request of the Secretary of Agriculture, it shall be the duty of the several district attorneys of the United States, in their respective districts, under the directions of the Attorney General, to institute proceedings to enforce the remedies and to collect the forfeitures provided for in, or pursuant to, this title. Whenever the Secretary, or such officer or employee of the Department of Agriculture as he may designate for the purpose, has reason to believe that any handler has violated, or is violating, the provisions of any order or amendment thereto issued pursuant to this title, the Secretary shall have power to institute an investigation and, after due notice to such handler, to conduct a hearing in order to determine the facts for the purpose of referring the matter to the Attorney General for appropriate action.

(8) The remedies provided for in this section shall be in addition to, and not exclusive of, any of the remedies or penalties provided for elsewhere in this title or now or hereafter existing at law or in equity.

(9) The term "person" as used in this title includes an individual, partnership, corporation, association, and any other business unit. (7 U. S. C. 608a)]

(d) Section 8b (relating to marketing agreements);

MARKETING AGREEMENTS

[SEC. 8b. In order to effectuate the declared policy of this title, the Secretary of Agriculture shall have the power, after due notice and opportunity for hearing, to enter into marketing agreements with processors, producers, associations of producers, and others engaged in the handling of any agricultural commodity or product thereof, only with respect to such handling as is in the current of interstate or foreign commerce or which directly burdens, obstructs, or affects, interstate or foreign commerce in such commodity or product thereof. The making of any such agreement shall not be held to be in violation of any of the antitrust laws of the United States, and any such agreement shall be deemed to be lawful: *Provided*, That no such agreement shall remain in force after the termination of this Act. (7 U. S. C. 608b)]

(e) Section 8c (relating to orders);

ORDERS

[SEC. 8c. (1) The Secretary of Agriculture shall, subject to the provisions of this section, issue, and from time to time amend, orders applicable to processors, associations of producers, and others engaged in the handling of any agricultural commodity or product thereof specified in subsection (2) of this section. Such persons are

referred to in this title as "handlers." Such orders shall regulate, in the manner hereinafter in this section provided, only such handling of such agricultural commodity, or product thereof, as is in the current of interstate or foreign commerce, or which directly burdens, obstructs, or affects, interstate or foreign commerce in such commodity or product thereof.

COMMODITIES TO WHICH APPLICABLE

(2) Orders issued pursuant to this section shall be applicable only to the following agricultural commodities and the products thereof (except canned or frozen grapefruit, the products of naval stores, and the products of honeybees), or to any regional, or market classification of any such commodity or product: Milk, fruits (including filberts, almonds,[4] pecans and walnuts but not including apples, other than apples produced in the States of Washington, Oregon, and Idaho, and not including fruits, other than olives and grapefruit, for canning or freezing), tobacco, vegetables (not including vegetables, other than asparagus, for canning or freezing), soybeans, hops, honeybees and naval stores as included in the Naval Stores Act and standards established thereunder (including refined or partially refined oleoresin): *Provided*, That no order issued pursuant to this section shall be effective as to any grapefruit for canning or freezing unless the Secretary of Agriculture determines, in addition to other findings and determinations required by this Act, that the issuance of such order is approved or favored by the processors who, during a representative period determined by the Secretary, have been engaged in canning or freezing such commodity for market and have canned or frozen for market more than 50 per centum of the total volume of such commodity canned or frozen for market during such representative period.[5]

NOTICE AND HEARING

(3) Whenever the Secretary of Agriculture has reason to believe that the issuance of an order will tend to effectuate the declared policy of this title with respect to any commodity or product thereof specified in subsection (2) of this section, he shall give due notice of and an opportunity for a hearing upon a proposed order.

FINDING AND ISSUANCE OF ORDER

(4) After such notice and opportunity for hearing, the Secretary of Agriculture shall issue an order if he finds, and sets forth in such order, upon the evidence introduced at such hearing (in addition to such other findings as may be specifically required by this section) that the issuance of such order and all of the terms and conditions thereof will tend to effectuate the declared policy of this title with respect to such commodity.

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[4] The words "filberts, almonds" were added by the Act of June 29, 1949, 63 Stat. 282.
[5] The provisions of subsec. (2) were substituted for the previous provisions by sec. 401 of the Agricultural Act of 1954.

TERMS—MILK AND ITS PRODUCTS

(5) In the case of milk and its products, orders issued pursuant to this section shall contain one or more of the following terms and conditions, and (except as provided in subsection (7)) no others:

(A) Classifying milk in accordance with the form in which or the purpose for which it is used, and fixing, or providing a method for fixing, minimum prices for each such use classification which all handlers shall pay, and the time when payments shall be made for milk purchased from producers or associations of producers. Such prices shall be uniform as to all handlers, subject only to adjustments for (1) volume, market, and production differentials customarily applied by the handlers subject to such order, (2) the grade or quality of the milk purchased, and (3) the locations at which delivery of such milk, or any use classification thereof, is made to such handlers.

(B) Providing:

(i) for the payment to all producers and associations of producers delivering milk to the same handler of uniform prices for all milk delivered by them: *Provided*, That, except in the case of orders covering milk products only, such provision is approved or favored by at least three-fourths of the producers who, during a representative period determined by the Secretary of Agriculture, have been engaged in the production for market of milk covered in such order or by producers who, during such representative period, have produced at least three-fourths of the volume of such milk produced for market during such period; the approval required hereunder shall be separate and apart from any other approval or disapproval provided for by this section; or

(ii) for the payment to all producers and associations of producers delivering milk to all handlers of uniform prices for all milk so delivered, irrespective of the uses made of such milk by the individual handler to whom it is delivered;

subject, in either case, only to adjustments for (a) volume, market, and production differentials customarily applied by the handlers subject to such order, (b) the grade or quality of the milk delivered, (c) the locations at which delivery of such milk is made, and (d) a further adjustment, equitably to apportion the total value of the milk purchased by any handler, or by all handlers, among producers and associations of producers, on the basis of their marketings of milk during a representative period of time.

(C) In order to accomplish the purposes set forth in paragraphs (A) and (B) of this subsection (5), providing a method for making adjustments in payments, as among handlers (including producers who are also handlers), to the end that the total sums paid by each handler shall equal the value of the milk purchased by him at the prices fixed in accordance with paragraph (A) hereof.

(D) Providing that, in the case of all milk purchased by handlers from any producer who did not regularly sell milk during a period of 30 days next preceding the effective date of such order for consumption in the area covered thereby, payments to such producer, for the period beginning with the first regular delivery by such pro-

ducer and continuing until the end of two full calendar months following the first day of the next succeeding calendar month, shall be made at the price for the lowest use classification specified in such order, subject to the adjustments specified in paragraph (B) of this subsection (5).

(E) Providing (i) except as to producers for whom such services are being rendered by a cooperative marketing association, qualified as provided in paragraph (F) of this subsection (5), for market information to producers and for the verification of weights, sampling, and testing of milk purchased from producers, and for making appropriate deductions therefor from payments to producers, and (ii) for assurance of, and security for, the payment by handlers for milk purchased.

(F) Nothing contained in this subsection (5) is intended or shall be construed to prevent a cooperative marketing association qualified under the provisions of the Act of Congress of February 18, 1922, as amended, known as the "Capper-Volstead Act," engaged in making collective sales or marketing of milk or its products for the producers thereof, from blending the net proceeds of all its sales in all markets in all use classifications, and making distribution thereof to its producers in accordance with the contract between the association and its producers: *Provided*, That it shall not sell milk or its products to any handler for use or consumption in any market at prices less than the prices fixed pursuant to paragraph (A) of this subsection (5) for such milk.

(G) No marketing agreement or order applicable to milk and its products in any marketing area shall prohibit or in any manner limit, in the case of the products of milk, the marketing in that area of any milk or product thereof produced in any production area in the United States.

TERMS—OTHER COMMODITIES

(6) In the case of the agricultural commodities and the products thereof, other than milk and its products, specified in subsection (2) orders issued pursuant to this section shall contain one or more of the following terms and conditions, and (except as provided in subsection (7)), no others:[6]

(A) Limiting, or providing methods for the limitation of, the total quantity of any such commodity or product, or of any grade, size, or quality thereof, produced during any specified period or periods, which may be marketed in or transported to any or all markets in the current of interstate or foreign commerce or so as directly to burden, obstruct, or affect interstate or foreign commerce in such commodity or product thereof, during any specified period or periods by all handlers thereof.

(B) Allotting, or providing methods for allotting, the amount of such commodity or product, or any grade, size, or quality thereof, which each handler may purchase from or handle on behalf of any and all producers thereof, during any specified period or periods, under a uniform rule based upon the amounts sold by such producers in such prior period as the Secretary determines to be representative,

[6] The provisions of this paragraph were substituted for the previous provisions by sec. 401 of the Agricultural Act of 1954.

or upon the current quantities available for sale by such producers, or both, to the end that the total quantity thereof to be purchased, or handled during any specified period or periods shall be apportioned equitably among producers.

(C) Allotting, or providing methods for allotting, the amount of any such commodity or product, or any grade, size, or quality thereof, which each handler may market in or transport to any or all markets in the current of interstate or foreign commerce or so as directly to burden, obstruct, or affect interstate or foreign commerce in such commodity or product thereof, under a uniform rule based upon the amounts which each such handler has available for current shipment, or upon the amounts shipped by each such handler in such prior period as the Secretary determines to be representative, or both, to the end that the total quantity of such commodity or product, or any grade, size, or quality thereof, to be marketed in or transported to any or all markets in the current of interstate or foreign commerce or so as directly to burden, obstruct, or affect interstate or foreign commerce in such commodity or product thereof, during any specified period or periods shall be equitably apportioned among all of the handlers thereof.

(D) Determining, or providing methods for determining, the existence and extent of the surplus of any such commodity or product, or of any grade, size, or quality thereof, and providing for the control and disposition of such surplus, and for equalizing the burden of such surplus elimination or control among the producers and handlers thereof.

(E) Establishing or providing for the establishment of reserve pools of any such commodity or product, or of any grade, size, or quality thereof, and providing for the equitable distribution of the net return derived from the sale thereof among the persons beneficially interested therein.

(F) Requiring or providing for the requirement of inspection of any such commodity or product produced during specified periods and marketed by handlers.

(G) In the case of hops and their products, in addition to, or in lieu of, the foregoing terms and conditions, orders may contain one or more of the following:

(i) Limiting, or providing methods for the limitation of, the total quantity thereof, or of any grade, type, or variety thereof, produced during any specified period or periods, which all handlers may handle in the current of or so as directly to burden, obstruct, or affect interstate or foreign commerce in hops or any product thereof.

(ii) Apportioning, or providing methods for apportioning, the total quantity of hops of the production of the then current calendar year permitted to be handled equitably among all producers in the production area to which the order applies upon the basis of one or more or a combination of the following: The total quantity of hops available or estimated will become available for market by each producer from his production during such period; the normal production of the acreage of hops operated by each producer during such period upon the basis of the number of acres of hops in production, and the average yield of that acreage during such period as the Secretary determines to be representative, with adjustments de-

termined by the Secretary to be proper for age of plantings or abnormal conditions affecting yield; such normal production or historical record of any acreage for which data as to yield of hops are not available or which had no yield during such period shall be determined by the Secretary on the basis of the yields of other acreage of hops of similar characteristics as to productivity, subject to adjustment as just provided for.

(iii) Allotting, or providing methods for allotting, the quantity of hops which any handler may handle so that the allotment fixed for that handler shall be limited to the quantity of hops apportioned under preceding section (ii) to each respective producer of hops; such allotment shall constitute an allotment fixed for that handler within the meaning of subsection (5) of section 8a of this title (U. S. C., 1940 edition, title 7, sec. 608a).

(H) providing a method for fixing the size, capacity, weight, dimensions, or pack of the container, or containers, which may be used in the packaging, transportation, sale, shipment, or handling of any fresh or dried fruits, vegetable, or tree nuts: *Provided, however*, That no action taken hereunder shall conflict with the Standard Containers Act of 1916 (15 U. S. C. 251–256) and the Standard Containers Act of 1928 (15 U. S. C. 257–257i);[7]

(I) establishing or providing for the establishment of marketing research and development projects designed to assist, improve, or promote the marketing, distribution, and consumption of any such commodity or product, the expense of such projects to be paid from funds collected pursuant to the marketing order.[7]

TERMS COMMON TO ALL ORDERS

(7) In the case of the agricultural commodities and the products thereof specified in subsection (2) orders shall contain one or more of the following terms and conditions:

(A) Prohibiting unfair methods of competition and unfair trade practices in the handling thereof.

(B) Providing that (except for milk and cream to be sold for consumption in fluid form) such commodity or product thereof, or any grade, size, or quality thereof shall be sold by the handlers thereof only at prices filed by such handlers in the manner provided in such order.

(C) Providing for the selection by the Secretary of Agriculture, or a method for the selection, of an agency or agencies and defining their powers and duties, which shall include only the powers:

(i) To administer such order in accordance with its terms and provisions;

(ii) To make rules and regulations to effectuate the terms and provisions of such order;

(iii) To receive, investigate, and report to the Secretary of Agriculture complaints of violations of such order; and

(iv) To recommend to the Secretary of Agriculture amendments to such order.

No person acting as a member of an agency established pursuant to this paragraph (C) shall be deemed to be acting in an official capac-

[7] Pars. (H) and (I) were added by sec. 401 of the Agricultural Act of 1954.

ity, within the meaning of section 10 (g) of this title, unless such person receives compensation for his personal services from funds of the United States. There shall be included in the membership of any agency selected to administer a marketing order applicable to grapefruit for canning or freezing one or more representatives of processors of the commodity specified in such order.[8]

(D) Incidental to, and not inconsistent with, the terms and conditions specified in subsections (5), (6) and (7) and necessary to effectuate the other provisions of such order.

ORDERS WITH MARKETING AGREEMENT

(8) Except as provided in subsection (9) of this section, no order issued pursuant to this section shall become effective until the handlers (excluding cooperative associations of producers who are not engaged in processing, distributing, or shipping the commodity or product thereof covered by such order) of not less than 50 per centum of the volume of the commodity or product thereof covered by such order which is produced or marketed within the production or marketing area defined in such order have signed a marketing agreement, entered into pursuant to section 8b of this title, which regulates the handling of such commodity or product in the same manner as such order, except that as to citrus fruits produced in any area producing what is known as California citrus fruits no order issued pursuant to this subsection (8) shall become effective until the handlers of not less than 80 per centum of the volume of such commodity or product thereof covered by such order have signed such a marketing agreement: *Provided*, That no order issued pursuant to this subsection shall be effective unless the Secretary of Agriculture determines that the issuance of such order is approved or favored:

(A) By at least two-thirds of the producers who (except that as to citrus fruits produced in any area producing what is known as California citrus fruits said order must be approved or favored by three-fourths of the producers), during a representative period determined by the Secretary, have been engaged, within the production area specified in such marketing agreement or order, in the production for market of the commodity specified therein, or who, during such representative period, have been engaged in the production of such commodity for sale in the marketing area specified in such marketing agreement, or order, or

(B) By producers who, during such representative period, have produced for market at least two-thirds of the volume of such commodity produced for market within the production area specified in such marketing agreement or order, or who, during such representative period, have produced at least two-thirds of the volume of such commodity sold within the marketing area specified in such marketing agreement or order.

ORDERS WITH OR WITHOUT MARKETING AGREEMENT

(9) Any order issued pursuant to this section shall become effective in the event that, notwithstanding the refusal or failure of han-

[8] This sentence was added by sec. 401 of the Agricultural Act of 1954.

dlers (excluding cooperative associations of producers who are not engaged in processing, distributing, or shipping the commodity or product thereof covered by such order) of more than 50 per centum of the volume of the commodity or product thereof (except that as to citrus fruits produced in any area producing what is known as California citrus fruits said per centum shall be 80 per centum) covered by such order which is produced or marketed within the production or marketing area defined in such order to sign a marketing agreement relating to such commodity or product thereof, on which a hearing has been held, the Secretary of Agriculture, with the approval of the President,[9] determines:

(A) That the refusal or failure to sign a marketing agreement (upon which a hearing has been held) by the handlers (excluding cooperative associations of producers who are not engaged in processing, distributing, or shipping the commodity or product thereof covered by such order) of more than 50 per centum of the volume of the commodity or product thereof (except that as to citrus fruits produced in any area producing what is known as California citrus fruits said per centum shall be 80 per centum) specified therein which is produced or marketed within the production or marketing area specified therein tends to prevent the effectuation of the declared policy of this title with respect to such commodity or product, and

(B) That the issuance of such order is the only practical means of advancing the interests of the producers of such commodity pursuant to the declared policy, and is approved or favored:

(i) By at least two-thirds of the producers (except that as to citrus fruits produced in any area producing what is known as California citrus fruits said order must be approved or favored by three-fourths of the producers) who, during a representative period determined by the Secretary, have been engaged, within the production area specified in such marketing agreement or order, in the production for market of the commodity specified therein, or who, during such representative period, have been engaged in the production of such commodity for sale in the marketing area specified in such marketing agreement, or order, or

(ii) By producers who, during such representative period, have produced for market at least two-thirds of the volume of such commodity produced for market within the production area specified in such marketing agreement or order, or who, during such representative period, have produced at least two-thirds of the volume of such commodity sold within the marketing area specified in such marketing agreement order.

MANNER OF REGULATION AND APPLICABILITY

(10) No order shall be issued under this section unless it regulates the handling of the commodity or product covered thereby in the same manner as, and is made applicable only to persons in the respective classes of industrial or commercial activity specified in, a marketing agreement upon which a hearing has been held. No order shall be issued under this title prohibiting, regulating, or restricting the advertising of any commodity or product covered thereby,

[9] 1947 Reorganization Plan No. 1 abolished this function of the President.

nor shall any marketing agreement contain any provision prohibiting, regulating, or restricting the advertising of any commodity or product covered by such marketing agreement.

REGIONAL APPLICATION

(11) (A) No order shall be issued under this section which is applicable to all production areas or marketing areas, or both, of any commodity or product thereof unless the Secretary finds that the issuance of several orders applicable to the respective regional production areas or regional marketing areas, or both, as the case may be, of the commodity or product would not effectively carry out the declared policy of this title.

(B) Except in the case of milk and its products, orders issued under this section shall be limited in their application to the smallest regional production areas or regional marketing areas, or both, as the case may be, which the Secretary finds practicable, consistently with carrying out such declared policy.

(C) All orders issued under this section which are applicable to the same commodity or product thereof shall, so far as practicable, prescribe such different terms, applicable to different production areas and marketing areas, as the Secretary finds necessary to give due recognition to the differences in production and marketing of such commodity or product in such areas.

COOPERATIVE ASSOCIATION REPRESENTATION

(12) Whenever, pursuant to the provisions of this section, the Secretary is required to determine the approval or disapproval of producers with respect to the issuance of any order, or any term or condition thereof, or the termination thereof, the Secretary shall consider the approval or disapproval by any cooperative association of producers, bona fide engaged in marketing the commodity or product thereof covered by such order, or in rendering services for or advancing the interests of the producers of such commodity, as the approval or disapproval of the producers who are members of, stockholders in, or under contract with, such cooperative association of producers.

RETAILER AND PRODUCER EXEMPTION

(13) (A) No order issued under subsection (9) of this section shall be applicable to any person who sells agricultural commodities or products thereof at retail in his capacity as such retailer, except to a retailer in his capacity as a retailer of milk and its products.

(B) No order issued under this title shall be applicable to any producer in his capacity as a producer.

VIOLATION OF ORDER

(14) Any handler subject to an order issued under this section, or any officer, director, agent, or employee of such handler, who violates any provision of such order (other than a provision calling for payment of a pro rata share of expenses) shall, on conviction, be fined

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not less than $50 or more than $500 for each such violation, and each day during which such violation continues shall be deemed a separate violation: *Provided*, That if the court finds that a petition pursuant to subsection (15) of this section was filed and prosecuted by the defendant in good faith and not for delay, no penalty shall be imposed under this subsection for such violations as occurred between the date upon which the defendant's petition was filed with the Secretary, and the date upon which notice of the Secretary's ruling thereon was given to the defendant in accordance with regulations prescribed pursuant to subsection (15).

PETITION BY HANDLER AND REVIEW

(15) (A) Any handler subject to an order may file a written petition with the Secretary of Agriculture, stating that any such order or any provision of any such order or any obligation imposed in connection therewith is not in accordance with law and praying for a modification thereof or to be exempted therefrom. He shall thereupon be given an opportunity for a hearing upon such petition, in accordance with regulations made by the Secretary of Agriculture, with the approval of the President. After such hearing, the Secretary shall make a ruling upon the prayer of such petition which shall be final, if in accordance with law.

(B) The District Courts of the United States[10] in any district in which such handler is an inhabitant, or has his principal place of business, are hereby vested with jurisdiction in equity to review such ruling, provided a bill in equity for that purpose is filed within twenty days from the date of the entry of such ruling. Service of process in such proceedings may be had upon the Secretary by delivering to him a copy of the bill of complaint. If the court determines that such ruling is not in accordance with law, it shall remand such proceedings to the Secretary with directions either (1) to make such ruling as the court shall determine to be in accordance with law, or (2) to take such further proceedings as, in its opinion, the law requires. The pendency of proceedings instituted pursuant to this subsection (15) shall not impede, hinder, or delay the United States or the Secretary of Agriculture from obtaining relief pursuant to section 8a (6) of this title. Any proceedings brought pursuant to section 8a (6) of this title (except where brought by way of counterclaim in proceedings instituted pursuant to this subsection (15) shall abate whenever a final decree has been rendered in proceedings between the same parties, and covering the same subject matter, instituted pursuant to this subsection (15).

TERMINATION OF ORDERS AND MARKETING AGREEMENTS

(16) (A) The Secretary of Agriculture shall, whenever he finds that any order issued under this section, or any provision thereof, obstructs or does not tend to effectuate the declared policy of this title, terminate or suspend the operation of such order or such provision thereof.

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10 The reference to the district court of the United States for the District of Columbia has been deleted as superfluous. See 28 U. S. C. 88, 132a.

(B) The Secretary shall terminate any marketing agreement entered into under section 8b, or order issued under this section, at the end of the then current marketing period for such commodity, specified in such marketing agreement or order, whenever he finds that such termination is favored by a majority of the producers who, during a representative period determined by the Secretary, have been engaged in the production for market of the commodity specified in such marketing agreement or order, within the production area specified in such marketing agreement or order, or who, during such representative period, have been engaged in the production of such commodity for sale within the marketing area specified in such marketing agreement or order: *Provided*, That such majority have, during such representative period, produced for market more than 50 per centum of the volume of such commodity produced for market within the production area specified in such marketing agreement or order, or have, during such representative period, produced more than 50 per centum of the volume of such commodity sold in the marketing area specified in such marketing agreement or order, but such termination shall be effective only if announced on or before such date (prior to the end of the then current marketing period) as may be specified in such marketing agreement or order.

(C) The termination or suspension of any order or amendment thereto or provision thereof, shall not be considered an order within the meaning of this section.

PROVISIONS APPLICABLE TO AMENDMENTS

(17) The provisions of this section, section 8d,[11] applicable to orders shall be applicable to amendments to orders: *Provided*, That notice of a hearing upon a proposed amendment to any order issued pursuant to section 8c, given not less than three days prior to the date fixed for such hearing, shall be deemed due notice thereof.

MILK PRICES

(18) The Secretary of Agriculture, prior to prescribing any term in any marketing agreement or order, or amendment thereto, relating to milk or its products, if such term is to fix minimum prices to be paid to producers or associations of producers, or prior to modifying the price fixed in any such term, shall ascertain the parity prices of such commodities. The prices which it is declared to be the policy of Congress to establish in section 2 of this title shall, for the purposes of such agreement, order, or amendment, be adjusted to reflect the price of feeds, the available supplies of feeds, and other economic conditions which affect market supply and demand for milk or its products in the marketing area to which the contemplated marketing agreement, order, or amendment relates. Whenever the Secretary finds, upon the basis of the evidence adduced at the hearing required by section 8b or 8c, as the case may be, that the parity prices of such commodities are not reasonable in view of the price of feeds, the available supplies of feeds, and other economic

[11] The reference to the old sec. 8e (repealed) was deleted by 302 of the Agricultural Act of 1948 (July 3, 1948, 62 Stat. 1247).

conditions which affect market supply and demand for milk and its products in the marketing area to which the contemplated agreement, order, or amendment relates, he shall fix such prices as he finds will reflect such factors, insure a sufficient quantity of pure and wholesome milk, and be in the public interest. Thereafter, as the Secretary finds necessary on account of changed circumstances, he shall, after due notice and opportunity for hearing, make adjustments in such prices.[12]

PRODUCER REFERENDUM

(19) For the purpose of ascertaining whether the issuance of an order is approved or favored by producers, as required under the applicable provisions of this title, the Secretary may conduct a referendum among producers. The requirements of approval or favor under any such provision shall be held to be complied with if, of the total number or producers, or the total volume of production, as the case may be, represented in such referendum, the percentage approving or favoring is equal to or in excess of the percentage required under such provision. Nothing in this subsection shall be construed as limiting representation by cooperative associations as provided in subsection (12). (7 U. S. C. 608c.)]

(f) Section 8d (relating to books and records);

BOOKS AND RECORDS

[Sec. 8d. (1) All parties to any marketing agreement, and all handlers subject to an order, shall severally, from time to time, upon the request of the Secretary, furnish him with such information as he finds to be necessary to enable him to ascertain and determine the extent to which such agreement or order has been carried out or has effectuated the declared policy of this title, and with such information as he finds to be necessary to determine whether or not there has been any abuse of the privilege of exemptions from the antitrust laws. Such information shall be furnished in accordance with forms of reports to be prescribed by the Secretary. For the purpose of ascertaining the correctness of any report made to the Secretary pursuant to this subsection, or for the purpose of obtaining the information required in any such report, where it has been requested and has not been furnished, the Secretary is hereby authorized to examine such books, papers, records, copies of income-tax reports, accounts, correspondence, contracts, documents, or memoranda, as he deems relevant and which are within the control (1) of any such party to such marketing agreement, or any such handler, from whom such report was requested or (2) of any person having, either directly or indirectly, actual or legal control of or over such party or such handler or (3) of any subsidiary of any such party, handler, or person.

(2) Notwithstanding the provisions of section 7, all information furnished to or acquired by the Secretary of Agriculture pursuant to this section shall be kept confidential by all officers and employees

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[12] The provisions of this section were substituted for the previous provisions by sec. 302 of the Agricultural Act of 1948 (July 3, 1948, 62 Stat. 1247).

of the Department of Agriculture and only such information so furnished or acquired as the Secretary deems relevant shall be disclosed by them, and then only in a suit or administrative hearing brought at the direction, or upon the request, of the Secretary of Agriculture, or to which he or any officer of the United States is a party, and involving the marketing agreement or order with reference to which the information so to be disclosed was furnished or acquired. Nothing in this section shall be deemed to prohibit (A) the issuance of general statements based upon the reports of a number of parties to a marketing agreement or of handlers subject to an order, which statements do not identify the information furnished by any person, or (B) the publication by direction of the Secretary of the name of any person violating any marketing agreement or any order, together with a statement of the particular provisions of the marketing agreement or order violated by such person. Any such officer or employee violating the provisions of this section shall upon conviction be subject to a fine or not more than $1,000 or to imprisonment for not more than one year, or to both, and shall be removed from office. (7 U. S. C. 608d)]

(g) Section 8e; [13]

RESTRICTIONS ON IMPORTED COMMODITIES

[SEC. 8e.[14] Notwithstanding any other provision of law, whenever a marketing order issued by the Secretary of Agriculture pursuant to section 8c of this Act contains any terms or conditions regulating the grade, size, quality, or maturity of tomatoes, avocados, mangoes, limes, grapefruit, green peppers, Irish potatoes, cucumbers, or eggplants produced in the United States the importation into the United States of any such commodity during the period of time such order is in effect shall be prohibited unless it complies with the grade, size, quality, and maturity provisions of such order or comparable restrictions promulgated hereunder: *Provided*, That this prohibition shall not apply to such commodities when shipped into continental United States from the Commonwealth of Puerto Rico or any Territory or possession of the United States where this Act has force and effect: *Provided further*, That whenever two or more such marketing orders regulating the same agricultural commodity produced in different areas of the United States are concurrently in effect, the importation into the United States of any such commodity shall be prohibited unless it complies with the grade, size, quality, and maturity provisions of the order which, as determined by the Secretary of Agriculture, regulates the commodity produced in the area with which the imported commodity is in most direct competition. Such prohibition shall not become effective until after the giving of such notice as the Secretary of Agriculture determines reasonable, which shall not be less than three days. In determining the amount of notice that is reasonable in the case of tomatoes the Secretary of Agriculture shall give due consideration to the time required for

[13] The original provisions of this section were repealed by sec. 302 of the Agricultural Act of 1948.

[14] Added by sec. 401 (e) of the Agricultural Act of 1954. The word "mangoes" was inserted by sec. 3 of the Act of August 31, 1954, 68 Stat. 1047. This Department issued regulations under sec. 8e on November 24, 1954 (19 F. R. 7707).

their transportation and entry into the United States after picking. Whenever the Secretary of Agriculture finds that the application of the restrictions under a marketing order to an imported commodity is not practicable because of variations in characteristics between the domestic and imported commodity he shall establish with respect to the imported commodity such grade, size, quality, and maturity restrictions by varieties, types, or other classifications as he finds will be equivalent or comparable to those imposed upon the domestic commodity under such order. The Secretary of Agriculture may promulgate such rules and regulations as he deems necessary, to carry out the provisions of this section. Any person who violates any provision of this section or of any rule, regulation, or order promulgated hereunder shall be subject to a forfeiture in the amount prescribed in section 8a (5) or, upon conviction, a penalty in the amount prescribed in section 8c (14) of the Act, or to both such forfeiture and penalty. (8 U. S. C. 608e–1)]

(h) Section 10 (a), (b) (2), (c), (f), (g), (h), and (i) (miscellaneous provisions);

MISCELLANEOUS

[Sec. 10. (a) The Secretary of Agriculture may appoint such officers and employees, subject to the provisions of the Classification Act of 1949[15] and Acts amendatory thereof, and such experts as are necessary to execute the functions vested in him by this title; and the Secretary may make such appointments without regard to the civil service laws or regulations: *Provided*, That no salary in excess of $10,000 per annum shall be paid to any officer, employee, or expert of the Agricultural Adjustment Administration, which the Secretary shall establish in the Department of Agriculture for the administration of the functions vested in him by this title: *And provided further*, That the State Administrator appointed to administer this Act in each State shall be appointed by the President, by and with the advice and consent of the Senate. Title II of the Act entitled "An Act to maintain the credit of the United States Government", approved March 20, 1933, to the extent that it provides for the impoundment of appropriations on account of reductions in compensation, shall not operate to require such impoundment under appropriations contained in this Act.

(b) (1) The Secretary of Agriculture is authorized to establish, for the more effective administration of the functions vested in him by this title, State and local committees, or associations of producers, and to permit cooperative associations of producers, when in his judgment they are qualified to do so, to act as agents of their members and patrons in connection with the distribution of payments authorized to be made under section 8. The Secretary, in the administration of this title shall accord such recognition and encouragement to producer-owned and producer-controlled cooperative associations as will be in harmony with the policy toward cooperative associations set forth in existing Acts of Congress, and as will tend to promote efficient methods of marketing and distribution.

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[15] "1949" substituted for "1923" by the Act of October 28, 1949, 63 Stat. 972.

(2) (i) Each order relating to milk and its products issued by the Secretary under this title shall provide that each handler subject thereto shall pay to any authority or agency established under such order such handler's pro rata share (as approved by the Secretary) of such expenses as the Secretary may find will necessarily be incurred by such authority or agency, during any period specified by him, for the maintenance and functioning of such authority or agency, other than expenses incurred in receiving, handling, holding, or disposing of any quantity of milk or products thereof received, handled, held, or disposed of by such authority or agency for the benefit or account of persons other than handlers subject to such order. The pro rata share of the expenses payable by a cooperative association of producers shall be computed on the basis of the quantity of milk or product thereof covered by such order which is distributed, processed, or shipped by such cooperative association of producers.

(ii) Each order relating to any other commodity or product issued by the Secretary under this title shall provide that each handler subject thereto shall pay to any authority or agency established under such order such handler's pro rata share (as approved by the Secretary) of such expenses as the Secretary may find are reasonable and are likely to be incurred by such authority or agency, during any period specified by him, for such purposes as the Secretary may, pursuant to such order, determine to be appropriate, and for the maintenance and functioning of such authority or agency, other than expenses incurred in receiving, handling, holding, or disposing of any quantity of a commodity received, handled, held, or disposed of by such authority or agency for the benefit or account of persons other than handlers subject to such order. The pro rata share of the expenses payable by a cooperative association of producers shall be computed on the basis of the quantity of the agricultural commodity or product thereof covered by such order which is distributed, processed, or shipped by such cooperative association of producers. The payment of assessments for the maintenance and functioning of such authority or agency, as provided for herein, may be required under a marketing agreement or marketing order throughout the period the marketing agreement or order is in effect and irrespective of whether particular provisions thereof are suspended or become inoperative.

(iii) Any authority or agency established under an order may maintain in its own name, or in the name of its members, a suit against any handler subject to an order for the collection of such handler's pro rata share of expenses. The several district courts of the United States are hereby vested with jurisdiction to entertain such suits regardless of the amount in controversy.

(c) The Secretary of Agriculture is authorized, with the approval of the President, to make such regulations with the force and effect of law as may be necessary to carry out the powers vested in him by this title. Any violation of any regulation shall be subject to such penalty, not in excess of $100, as may be provided therein.

* * * * * * *

(f) The provisions of this title shall be applicable to the United States and its possessions, except the Philippine Islands, the Virgin Islands, American Samoa, the Canal Zone, and the island of Guam; except that, in the case of sugar beets and sugarcane, the President, if he finds it necessary in order to effectuate the declared policy of this Act, is authorized by proclamation to make the provisions of this title applicable to the Philippine Islands, the Virgin Islands, American Samoa, the Canal Zone, and/or the island of Guam.

(g) No person shall, while acting in any official capacity in the administration of this title, speculate, directly or indirectly, in any agricultural commodity or product thereof, to which this title applies, or in contracts relating thereto, or in the stock or membership interests of any association or corporation engaged in handling, processing, or disposing of any such commodity or product. Any person violating this subsection shall upon conviction thereof be fined not more than $10,000 or imprisoned not more than two years, or both.

(h) For the efficient administration of the provisions of part 2 of this title, the provisions, including penalties, of sections 8, 9, and 10 of the Federal Trade Commission Act, approved September 26, 1914, are made applicable to the jurisdiction, powers, and duties of the Secretary in administering the provisions of this title and to any person subject to the provisions of this title, whether or not a corporation. Hearings authorized or required under this title shall be conducted by the Secretary of Agriculture or such officer or employee of the Department as he may designate for the purpose. The Secretary may report any violation of any agreement entered into under part 2 of this title to the Attorney General of the United States, who shall cause appropriate proceedings to enforce such agreement to be commenced and prosecuted in the proper courts of the United States without delay.

(i) The Secretary of Agriculture upon the request of the duly constituted authorities of any State is directed, in order to effectuate the declared policy of this title and in order to obtain uniformity in the formulation, administration, and enforcement of Federal and State programs relating to the regulation of the handling of agricultural commodities or products thereof, to confer with and hold joint hearings with the duly constituted authorities of any State, and is authorized to cooperate with such authorities; to accept and utilize, with the consent of the State, such State and local officers and employees as may be necessary; to avail himself of the records and facilities of such authorities; to issue orders (subject to the provisions of section 8c) complementary to orders or other regulations issued by such authorities; and to make available to such State authorities the records and facilities of the Department of Agriculture: *Provided*, That information furnished to the Secretary of Agriculture pursuant to section 8d (1) hereof shall be made available only to the extent that such information is relevant to transactions within the regulatory jurisdiction of such authorities, and then only upon a written agreement by such authorities that the information so furnished shall be kept confidential by them in a manner similar to that required of Federal officers and employees under the provisions of section 8d (2) hereof.

(j) The term "interstate or foreign commerce" means commerce between any State, Territory, or possession, or the District of Columbia, and any place outside thereof; or between points within the same State, Territory, or possession, or the District of Columbia, but through any place outside thereof; or within any Territory or possession, or the District of Columbia. For the purpose of this Act (but in nowise limiting the foregoing definition) a marketing transaction in respect to an agricultural commodity or the product thereof shall be considered in interstate or foreign commerce if such commodity or product is part of that current of interstate or foreign commerce usual in the handling of the commodity or product whereby they, or either of them, are sent from one State to end their transit, after purchase, in another, including all cases where purchase or sale is either for shipment to another State or for the processing within the State and the shipment outside the State of the products so processed. Agricultural commodities or products thereof normally in such current of interstate or foreign commerce shall not be considered out of such current through resort being had to any means or device intended to remove transactions in respect thereto from the provisions of this Act. As used herein the word "State" includes Territory, the District of Columbia, possession of the United States, and foreign nations.[16] (7 U. S. C. 610)]

(i) Section 12 (a) and (c) (relating to appropriation and expense);

APPROPRIATION

[Sec. 12. (a) There is hereby appropriated, out of any money in the Treasury not otherwise appropriated, the sum of $100,000,000 to be available to the Secretary of Agriculture for administrative expenses under this title and for payments authorized to be made under section 8. Such sum shall remain available until expended.

To enable the Secretary of Agriculture to finance, under such terms and conditions as he may prescribe, surplus reductions with respect to the dairy- and beef-cattle industries, and to carry out any of the purposes described in subsections (a) and (b) of this section (12) and to support and balance the markets for the dairy and beef cattle industries, there is authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, the sum of $200,000,000; *Provided*, That not more than 60 per centum of such amount shall be used for either of such industries.

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(c) The administrative expenses provided for under this section shall include, among others, expenditures for personal services and rent in the District of Columbia and elsewhere, for law books and books of reference, for contract stenographic reporting services, and for printing and paper in addition to allotments under the existing law. The Secretary of Agriculture shall transfer to the Treasury Department, and is authorized to transfer to other agencies, out of funds available for administrative expenses under this title, such sums as are required to pay administrative expenses incurred and

[16] Par. (j) added by sec. 2 (i) of the 1937 Act.

refunds made by such department or agencies in the administration of this title. (7 U. S. C. 612)]

(j) Section 14 (relating to separability);

SEPARABILITY OF PROVISIONS

[SEC. 14. If any provision of this title is declared unconstitutional, or the applicability thereof to any person, circumstance, or commodity is held invalid the validity of the remainder of this title and the applicability thereof to other persons, circumstances, or commodities shall not be affected thereby. (7 U. S. C. 714)]

(k) Section 22 (relating to imports);

IMPORTS[17]

[SEC. 22. (a) Whenever the Secretary of Agriculture has reason to believe that any article or articles are being or are practically certain to be imported into the United States under such conditions and in such quantities as to render or tend to render ineffective, or materially interfere with, any program or operation undertaken under this title or the Soil Conservation and Domestic Allotment Act, as amended, or section 32, Public Law numbered 320, Seventy-fourth Congress, approved August 24, 1935, as amended, or any loan, purchase, or other program or operation undertaken by the Department of Agriculture, or any agency operating under its direction, with respect to any agricultural commodity or product thereof, or to reduce substantially the amount of any product processed in the United States from any agricultural commodity or product thereof with respect to which any such program or operation is being undertaken, he shall so advise the President, and, if the President agrees that there is reason for such belief, the President shall cause an immediate investigation to be made by the United States Tariff Commission, which shall give precedence to investigations under this section to determine such facts. Such investigation shall be made after due notice and opportunity for hearing to interested parties, and shall be conducted subject to such regulations as the President shall specify. (7 U. S. C. 624 (a))

(b) If, on the basis of such investigation and report to him of findings and recommendations made in connection therewith, the President finds the existence of such facts, he shall by proclamation

17 See also sec. 202 (a) and 204 of the Agricultural Act of 1956. Sec. 22 was added by the Act of August 24, 1935 (49 Stat. 773). As originally enacted this section authorized the President to restrict the importations of any agricultural commodity or product whenever he found, after investigation by the Tariff Commission and on the basis of its findings and recommendations made pursuant thereto, that such importations were adversely affecting programs or operations under the Agricultural Adjustment Act of 1933. Sec. 22 has been amended several times and was revised in its entirety by sec. 3 of the Agricultural Act of 1948 (62 Stat. 1247) and again by sec. 3 of the Act of June 28, 1950 (64 Stat. 261). The President is now authorized to impose quantitative restrictions (quotas) and fees on any agricultural commodity or product whenever he finds, pursuant to appropriate proceedings by the Tariff Commission, that imports of such commodity or product adversely affect or seriously threaten any program or operation undertaken by the Department of Agriculture. The Secretary of Agriculture has the responsibility of advising the President regarding the need for action under sec. 22. In addition, the Secretary of Agriculture is charged with the responsibility of determining the need for emergency action under sec. 22 with respect to perishable agricultural commodities. Presidential Executive Order No. 7233, dated November 23, 1935, contains the regulations governing investigations under this section. For statement of the policies and procedures of the Department of Agriculture in discharging its responsibilities under sec. 22, see 17 F. R. 8287 (September 16, 1952).

impose such fees not in excess of 50 per centum ad valorem or such quantitative limitations on any article or articles which may be entered, or withdrawn from warehouse, for consumption as he finds and declares shown by such investigation to be necessary in order that the entry of such article or articles will not render or tend to render ineffective, or materially interfere with, any program or operation referred to in subsection (a) of this section, or reduce substantially the amount of any product processed in the United States from any such agricultural commodity or product thereof with respect to which any such program or operation is being undertaken: *Provided*, That no proclamation under this section shall impose any limitation on the total quantity of any article or articles which may be entered, or withdrawn from warehouse, for consumption which reduces such permissible total quantity to proportionately less than 50 per centum of the total quantity of such article or articles which was entered, or withdrawn from warehouse, for consumption during a representative period as determined by the President: *And provided further*, That in designating any article or articles, the President may describe them by physical qualities, value, use, or upon such other bases as he shall determine.

In any case where the Secretary of Agriculture determines and reports to the President with regard to any article or articles that a condition exists requiring emergency treatment, the President may take immediate action under this section without awaiting the recommendations of the Tariff Commission, such action to continue in effect pending the report and recommendations of the Tariff Commission and action thereon by the President.[18] (7 U. S. C. 624 (b))

(c) The fees and limitations imposed by the President by proclamation under this section and any revocation, suspension, or modification thereof, shall become effective on such date as shall be therein specified, and such fees shall be treated for administrative purposes and for the purposes of section 32 of Public Law numbered 320, Seventy-fourth Congress, approved August 24, 1935, as amended, as duties imposed by the Tariff Act of 1930, but such fees shall not be considered as duties for the purpose of granting any preferential concession under any international obligation of the United States. (7 U. S. C. 624 (c))

(d) After investigation, report, finding, and declaration in the manner provided in the case of a proclamation issued pursuant to subsection (b) of this section, any proclamation or provision of such proclamation may be suspended or terminated by the President whenever he finds and proclaims that the circumstances requiring the proclamation or provision thereof no longer exist or may be modified by the President whenever he finds and proclaims that changed circumstances require such modification to carry out the purposes of this section. (7 U. S. C. 624 (d))

(e) Any decision of the President as to facts under this section shall be final. (7 U. S. C. 624 (e))

(f) No trade agreement or other international agreement heretofore or hereafter entered into by the United States shall be applied

[18] Paragraph added by sec. 104 of the Trade Agreements Extension Act of 1953, 67 Stat. 472.

in a manner inconsistent with the requirements of this section.[19] (7 U. S. C. 624 (f))]

[TRADE AGREEMENTS EXTENSION ACT OF 1951,[20] AS AMENDED

SEC. 7. (a) Upon the request of the President, upon resolution of either House of Congress, upon resolution of either the Committee on Finance of the Senate or the Committee on Ways and Means of the House of Representatives, upon its own motion, or upon application of any interested party (including any organization or group of employees),[21] the United States Tariff Commission shall promptly make an investigation and make a report thereon not later than six months[22] after the application is made to determine whether any product upon which a concession has been granted under a trade agreement is, as a result, in whole or in part, of the duty or other customs treatment reflecting such concession, being imported into the United States in such increased quantities, either actual or relative, as to cause or threaten serious injury to the domestic industry producing like or directly competitive products.

In the course of any such investigation, whenever it finds evidence of serious injury or threat of serious injury or whenever so directed by resolution of either the Committee on Finance of the Senate or the Committee on Ways and Means of the House of Representatives, the Tariff Commission shall hold hearings giving reasonable public notice thereof and shall afford reasonable opportunity for interested parties to be present, to produce evidence, and to be heard at such hearings.

Should the Tariff Commission find, as the result of its investigation and hearings, that a product on which a concession has been granted is, as a result, in whole or in part, of the duty or other customs treatment reflecting such concession, being imported in such increased quantities, either actual or relative, as to cause or threaten serious injury to the domestic industry producing like or directly competitive products, it shall recommend to the President the withdrawal or modification of the concession, its suspension in whole or in part, or the establishment of import quotas, to the extent and for the time necessary to prevent or remedy such injury. Within sixty days, or sooner if the President has taken action under subsection (c) of this section, the Tariff Commission shall transmit to the Committee on Finance of the Senate and the Committee on Ways and Means of the House of Representatives an exact copy of its report and recommendations to the President.

(b) In arriving at a determination in the foregoing procedure the Tariff Commission, without excluding other factors, shall take into consideration a downward trend of production, employment, prices, profits, or wages in the domestic industry concerned, or a decline in sales, an increase in imports, either actual or relative to domestic

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19 The provisions of this subsec. (f) were substituted for the original provisions by sec. 8 (b) of the Trade Agreements Extension Act of 1951, approved June 16, 1951, 65 Stat. 72, 75.

20 June 16, 1951, 65 Stat. 72, 74, 75.

21 "Any interested party (including any organization or group of employees)" substituted for "any interested party" by the Act of August 20, 1958, Pub. L. 85-686, 85th Cong., 72 Stat. 676.

22 "Six months" substituted for "nine months" by the Act of August 20, 1958, Pub. L. 85-686, 85th Cong., 72 Stat. 676. "Nine months" substituted for "one year" by the Act of August 7, 1953, 67 Stat. 472.

production, a higher or growing inventory, or a decline in the proportion of the domestic market supplied by domestic producers.

(c) (1) Upon receipt of the Tariff Commission's report of its investigation and hearings, the President may make such adjustments in the rates of duty, impose such quotas, or make such other modifications as are found and reported by the Commission to be necessary to prevent or remedy serious injury to the respective domestic industry. If the President does not take such action within sixty days he shall immediately submit a report to the Committee on Ways and Means of the House and to the Committee on Finance of the Senate stating why he has not made such adjustments or modifications, or imposed such quotas.

(2) The action so found and reported by the Commission to be necessary shall take effect (as provided in the first sentence of paragraph (1) or in paragraph (3), as the case may be)—

(A) if approved by the President, or

(B) if disapproved by the President in whole or in part, upon the adoption by both Houses of the Congress (within the 60-day period following the date on which the report referred to in the second sentence of paragraph (1) is submitted to such committees), by the yeas and nays by a two-thirds vote of each House, of a concurrent resolution stating in effect that the Senate and House of Representatives approve the action so found and reported by the Commission to be necessary.

For the purposes of subparagraph (B), in the computation of the 60-day period there shall be excluded the days on which either House is not in session because of an adjournment of more than 3 days to a day certain or an adjournment of the Congress sine die.

(3) In any case in which the contingency set forth in paragraph (2) (B) occurs, the President shall (within 15 days after the adoption of such resolution) take such action as may be necessary to make the adjustments, impose the quotas, or make such other modifications as were found and reported by the Commission to be necessary.[23]

(d) When in the judgment of the Tariff Commission no sufficient reason exists for a recommendation to the President that a concession should be withdrawn or modified or a quota established, it shall make and publish a report stating its findings and conclusions. (19 U. S. C. 1364)

* * * * * * *

(f) In carrying out the provisions of this section the President may, notwithstanding section 350 (a) (2) of the Tariff Act of 1930, as amended, impose a duty not in excess of 50 per centum ad valorem on any article not otherwise subject to duty.[24]

SEC. 8. (a) In any case where the Secretary of Agriculture determines and reports to the President and to the Tariff Commission with regard to any agricultural commodity that due to the perishability of the commodity a condition exists requiring emergency treatment, the Tariff Commission shall make an immediate investigation under the provisions of section 22 of the Agricultural Adjustment Act, as amended, or under the provisions of section 7 of this

[23] Subsecs. (c) (2) and (c) (3) were added by the Act of August 20, 1958, Pub. L. 85-686, 72 Stat. 676.

[24] Subsec. (f) was added by the Act of August 20, 1958, Pub. L. 85-686, 72 Stat. 676.

Act to determine the facts and make recommendations to the President for such relief under those provisions as may be appropriate. The President may take immediate action however, without awaiting the recommendations of the Tariff Commission if in his judgment the emergency requires such action. In any case the report and findings of the Tariff Commission and the decision of the President shall be made at the earliest possible date in any event not more than 25 calendar days after the submission of the case to the Tariff Commission. (19 U. S. C. 1365)]

AMENDMENTS TO AGRICULTURAL ADJUSTMENT ACT

SEC. 2. The following provisions, reenacted in section 1 of this act, are amended as follows:

[Subsecs. (a) to (j) inclusive, of sec. 2 of the Agricultural Marketing Agreement Act of 1937 are incorporated in the preceding text and in the footnotes.]

ARBITRATION OF DISPUTES CONCERNING MILK

SEC. 3. (a) The Secretary of Agriculture, or such officer or employee of the Department of Agriculture as may be designated by him, upon written application of any cooperative association, incorporated or otherwise, which is in good faith owned or controlled by producers or organizations thereof, of milk or its products, and which is bona fide engaged in collective processing or preparing for market or handling or marketing (in the current of interstate or foreign commerce, as defined by paragraph (i) of section 2 of this act), milk or its products, may mediate and, with the consent of all parties, shall arbitrate if the Secretary has reason to believe that the declared policy of the Agricultural Adjustment Act, as amended, would be effectuated thereby, bona fide disputes, between such associations and the purchasers or handlers or processors or distributors of milk or its products, as to terms and conditions of the sale of milk or its products. The power to arbitrate under this section shall apply only to such subjects of the term or condition in dispute as could be regulated under the provisions of the Agricultural Adjustment Act, as amended, relating to orders for milk and its products.

(b) Meetings held pursuant to this section shall be conducted subject to such rules and regulations as the Secretary may prescribe.

(c) No award or agreement resulting from any such arbitration or mediation shall be effective unless and until approved by the Secretary of Agriculture, or such officer or employee of the Department of Agriculture as may be designated by him, and shall not be approved if it permits any unlawful trade practice or any unfair method of competition.

(d) No meeting so held and no award or agreement so approved shall be deemed to be in violation of any of the antitrust laws of the United States. (7 U. S. C. 671)

AGREEMENTS, ETC., UNAFFECTED

SEC. 4. (a) Nothing in this act shall be construed as invalidating any marketing agreement, license, or order, or any regulation relat-

ing to, or any provision of, or any act of the Secretary of Agriculture in connection with, any such agreement, license, or order which has been executed, issued, approved, or done under the Agricultural Adjustment Act, or any amendment thereof, but such marketing agreements, licenses, orders, regulations, provisions, and acts are hereby expressly ratified, legalized, and confirmed.

(b) Any program in effect under the Agricultural Adjustment Act, as reenacted and amended by this Act, on the effective date of section 302 of the Agricultural Act of 1948 shall continue in effect without the necessity for any amendatory action relative to such program, but any such program shall be continued in operation by the Secretary of Agriculture only to establish and maintain such orderly marketing conditions as will tend to effectuate the declared purpose set out in section 2 or 8c (18) of the Agricultural Adjustment Act, as reenacted and amended by this Act. (7 U. S. C. 672)[25]

TAXES UNDER AGRICULTURAL ADJUSTMENT ACT; PROVISIONS UNAFFECTED

SEC. 5. No processing taxes or compensating taxes shall be levied or collected under the Agricultural Adjustment Act, as amended. Except as provided in the preceding sentence, nothing in this act shall be construed as affecting provisions of the Agricultural Adjustment Act, as amended, other than those enumerated in section 1. The provisions so enumerated shall apply in accordance with their terms (as amended by this act) to the provisions of the Agricultural Adjustment Act, this act, and other provisions of law to which they have been heretofore made applicable. (7 U. S. C. 673)

SHORT TITLE

SEC. 6. This act may be cited as the "Agricultural Marketing Agreement Act of 1937." (7 U. S. C. 674)

RECOVERY ACTIONS BY PRODUCERS FOR COOPERATIVE PAYMENT

[Defense Production Act of 1950, as amended—Sec. 717 (d) [26]]

No action for the recovery of any cooperative payment made to a cooperative association by a Market Administrator under an invalid provision of a milk marketing order issued by the Secretary of Agriculture pursuant to the Agricultural Marketing Agreement Act of 1937 shall be maintained unless such action is brought by producers specifically named as party plaintiffs to recover their respective share of such payments within ninety days after the date of enactment of the Defense Production Act Amendments of 1952 with respect to any cause of action heretofore accrued and not otherwise barred, or within ninety days after accrual with respect to future payments, and unless each claimant shall allege and prove (1) that he objected at the hearing to the provisions of the order under which such payments were made and (2) that he either refused to accept

[25] Sec. 302 of the Agricultural Act of 1948 (62 Stat. 1247) inserted the subsection designation (a) and added subsec. (b).

[26] This section was added by sec. 120 of the Act of June 30, 1952, 66 Stat. 306.

payments computed with such deduction or accepted them under protest to either the Secretary or the Administrator. The district courts of the United States shall have exclusive original jurisdiction of all such actions regardless of the amount involved. This subsection shall not apply to funds held in escrow pursuant to court order. Notwithstanding any other provision of this Act, no termination date shall be applicable to this subsection. (50 App. U. S. C. 2166 (d)]

NATIONAL SCHOOL LUNCH ACT [1]

AN ACT

To provide assistance to the States in the establishment, maintenance, operation, and expansion of school-lunch programs, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National School Lunch Act." (42 U. S. C. 1751 note)

DECLARATION OF POLICY

SEC. 2. It is hereby declared to be the policy of Congress, as a measure of national security, to safeguard the health and well-being of the Nation's children and to encourage the domestic consumption of nutritious agricultural commodities and other food, by assisting the States, through grants-in-aid and other means, in providing an adequate supply of foods and other facilities for the establishment, maintenance, operation, and expansion of nonprofit school-lunch programs. (42 U. S. C. 1751)

APPROPRIATIONS AUTHORIZED

SEC. 3. For each fiscal year, beginning with the fiscal year ending June 30, 1947, there is hereby authorized to be appropriated, out of money in the Treasury not otherwise appropriated, such sums as may be necessary to enable the Secretary of Agriculture (hereinafter referred to as "the Secretary") to carry out the provisions of this Act. (42 U. S. C. 1752)

APPORTIONMENTS TO STATES

SEC. 4. The sums appropriated for any fiscal year pursuant to the authorization contained in section 3 of this Act, excluding the sum specified in section 5, shall be available to the Secretary for supplying, during such fiscal year, agricultural commodities and other foods for the school-lunch program in accordance with the provisions of this Act. The Secretary shall apportion among the States during each fiscal year not less than 75 per centum of the aforesaid funds made available for such year for supplying agricultural commodities and other foods under the provisions of this Act. The total of such apportionments of funds for use in Puerto Rico, Guam, and the Virgin Islands shall not exceed 3 per centum of the funds appropriated for agricultural commodities and other foods for the school-lunch program; except that in the case of the first apportionments of funds from any annual or supplemental appropriation (and only in such case), the apportionment for Puerto Rico, the apportionment

[1] June 4. 1946, 60 Stat. 230. See also sec. 201 (c) (relating to use of Commodity Credit Corporation funds to increase milk consumption in schools) (p. 125) and sec. 404 (relating to utilizing Commodity Credit Corporation in carrying out school lunch programs) (p. 130) of the Agricultural Act of 1949. Commodities set aside under title I of the Agricultural Act of 1954 (p. 138) may be donated to school-lunch programs pursuant to sec. 103 of that Act.

for Guam, and the apportionment for the Virgin Islands, shall be not less than that amount which will result in an allotment per child of school age equal to the allotment per child of school age in the State (other than Puerto Rico, Guam, and the Virgin Islands) having the lowest per capita income among the States participating in such first apportionments.[2] Apportionment among the States shall be made on the basis of two factors: (1) The number of school children in the State and (2) the need for assistance in the State as indicated by the relation of the per capita income in the United States to the per capita income in the State. The amount of the initial apportionment to any State shall be determined by the following method: First, determine an index for the State by multiplying factors (1) and (2); second, divide this index by the sum of the indices for all the States; and, finally, apply the figure thus obtained to the total funds to be apportioned. For the purpose of this section, the number of school children in the State shall be the number of children therein between the ages of five and seventeen, inclusive; such figures and per capita income figures shall be the latest figures certified by the Department of Commerce. For the purposes of this Act, "school" means any public or nonprofit private school of high-school grade or under and, with respect to Puerto Rico, shall also include nonprofit child-care centers certified as such by the Governor of Puerto Rico. If any State cannot utilize all funds so apportioned to it, or if additional funds are available under this Act for apportionment among the States, the Secretary shall make further apportionments to the remaining States in the same manner. (42 U. S. C. 1753)

NONFOOD ASSISTANCE

SEC. 5. Of the sums appropriated for any fiscal year pursuant to the authorization contained in section 3 of this Act, $10,000,000 shall be available to the Secretary for the purpose of providing, during such fiscal year, nonfood assistance for the school-lunch program pursuant to the provisions of this Act. The Secretary shall apportion among the States during each fiscal year the aforesaid sum of $10,000,000, and such apportionment among the States shall be on the basis of the factors, and in accordance with the standards, set forth in section 4 with respect to the apportionment for agricultural commodities and other foods. Apportionments of funds for use in Puerto Rico, Guam, and the Virgin Islands for nonfood assistance shall be determined subject to the provisions of the third sentence of section 4.[3] (42 U. S. C. 1754)

DIRECT FEDERAL EXPENDITURES

SEC. 6. The funds appropriated for any fiscal year for carrying out the provisions of this Act, less not to exceed 3½ per centum thereof hereby made available to the Secretary for his administrative expenses and less the amount apportioned by him pursuant to sections 4, 5, and 10, shall be available to the Secretary during such year for direct expenditure by him for agricultural commodities and other

[2] The two preceding sentences were substituted for the original provisions by the Act of July 12, 1952, 66 Stat. 591.
[3] This sentence was substituted for the original provision by the Act of July 12, 1952.

foods to be distributed among the States and schools participating in the school-lunch program under this Act in accordance with the needs as determined by the local school authorities. The provisions of law contained in the proviso of the Act of June 28, 1937 (50 Stat. 323), facilitating operations with respect to the purchase and disposition of surplus agricultural commodities under section 32 of the Act approved August 24, 1935 (49 Stat. 774), as amended, shall, to the extent not inconsistent with the provisions of this Act, also be applicable to expenditures of funds by the Secretary under this Act. (42 U. S. C. 1755)

PAYMENTS TO STATES

SEC. 7. Funds apportioned to any State pursuant to section 4 or 5 during any fiscal year shall be available for payment to such State for disbursement by the State educational agency, in accordance with such agreements not inconsistent with the provisions of this Act, as may be entered into by the Secretary and such State educational agency, for the purpose of assisting schools of that State during such fiscal year, in supplying (1) agricultural commodities and other foods for consumption by children and (2) nonfood assistance in furtherance of the school-lunch program authorized under this Act. Such payments to any State in any fiscal year during the period 1947 to 1950, inclusive, shall be made upon condition that each dollar thereof will be matched during such year by $1 from sources within the State determined by the Secretary to have been expended in connection with the school-lunch program under this Act. Such payments in any fiscal year during the period 1951 to 1955, inclusive, shall be made upon condition that each dollar thereof will be so matched by one and one-half dollars; and for any fiscal year thereafter, such payments shall be made upon condition that each dollar will be so matched by $3. In the case of any State whose per capita income is less than the per capita income of the United States, the matching required for any fiscal year shall be decreased by the percentage which the State per capita income is below the per capita income of the United States. For the purpose of determining whether the matching requirements of this section and section 10, respectively, have been met, the reasonable value of donated services, supplies, facilities, and equipment as certified, respectively, by the State educational agency and in case of schools receiving funds pursuant to section 10, by such schools (but not the cost or value of land, of the acquisition, construction, or alteration of buildings of commodities donated by the Secretary, or of Federal contributions), may be regarded as funds from sources within the State expended in connection with the school-lunch program. The Secretary shall certify to the Secretary of the Treasury from time to time the amounts to be paid to any State under this section and the time or times such amounts are to be paid; and the Secretary of the Treasury shall pay to the State at the time or times fixed by the Secretary the amounts so certified. (42 U. S. C. 1756)

STATE DISBURSEMENT TO SCHOOLS

SEC. 8. Funds paid to any State during any fiscal year pursuant to section 4 or 5 shall be disbursed by the State educational agency, in

accordance with such agreements approved by the Secretary as may be entered into by such State agency and the schools in the State, to those schools in the State which the State educational agency, taking into account need and attendance, determines are eligible to participate in the school-lunch program. Such disbursement to any school shall be made only for the purpose of reimbursing it for the cost of obtaining agricultural commodities and other foods for consumption by children in the school-lunch program and nonfood assistance in connection with such program. Such food costs may include, in addition to the purchase price of agricultural commodities and other foods, the cost of processing, distributing, transporting, storing, or handling thereof. In no event shall such disbursement for food to any school for any fiscal year exceed an amount determined by multiplying the number of lunches served in the school in the school-lunch program under this Act during such year by the maximum Federal food-cost contribution rate for the State, for the type of lunch served, as prescribed by the Secretary. (42 U. S. C. 1757)

NUTRITIONAL AND OTHER PROGRAM REQUIREMENTS

SEC. 9. Lunches served by schools participating in the school-lunch program under this Act shall meet minimum nutritional requirements prescribed by the Secretary on the basis of tested nutritional research. Such meals shall be served without cost or at a reduced cost to children who are determined by local school authorities to be unable to pay the full cost of the lunch. No physical segregation of or other discrimination against any child shall be made by the school because of his inability to pay. School-lunch programs under this Act shall be operated on a nonprofit basis. Each school shall, insofar as practicable, utilize in its lunch program commodities designated from time to time by the Secretary as being in abundance, either nationally or in the school area, or commodities donated by the Secretary. Commodities purchased under the authority of section 32 of the Act of August 24, 1935 (49 Stat. 774), as amended, may be donated by the Secretary to schools, in accordance with the needs as determined by local school authorities, for utilization in the school-lunch program under this Act as well as to other schools carrying out nonprofit school-lunch programs and institutions authorized to receive such commodities. (42 U. S. C. 1758)

NONPROFIT PRIVATE SCHOOLS

SEC. 10. If, in any State, the State educational agency is not permitted by law to disburse the funds paid to it under this Act to nonprofit private schools in the State, or is not permitted by law to match Federal funds made available for use by such nonprofit private schools, the Secretary shall withhold from the funds apportioned to any such State under sections 4 and 5 of this Act the same proportion of the funds as the number of children between the ages of five and seventeen, inclusive, attending nonprofit private schools within the State is of the total number of persons of those ages within the State attending school. The Secretary shall disburse the funds so withheld directly to the nonprofit private schools within said State for the same purposes and subject to the same conditions as are

authorized or required with respect to the disbursements to schools within the State by the State educational agency, including the requirement that any such payment or payments shall be matched, in the proportion specified in section 7 for such State, by funds from sources within the State expended by nonprofit private schools within the State participating in the school-lunch program under this Act. Such funds shall not be considered a part of the funds constituting the matching funds under the terms of section 7. (42 U. S. C. 1759)

MISCELLANEOUS PROVISIONS AND DEFINITIONS

SEC. 11. (a) States, State educational agencies, and schools participating in the school-lunch program under this Act shall keep such accounts and records as may be necessary to enable the Secretary to determine whether the provisions of this Act are being complied with. Such accounts and records shall at all times be available for inspection and audit by representatives of the Secretary and shall be preserved for such period of time, not in excess of five years, as the Secretary determines is necessary.

(b) The Secretary shall incorporate, in his agreements with the State educational agencies, the express requirements under this Act with respect to the operation of the school-lunch program under this Act insofar as they may be applicable and such other provisions as in his opinion are reasonably necessary or appropriate to effectuate the purposes of this Act.

(c) In carrying out the provisions of this Act, neither the Secretary nor the State shall impose any requirement with respect to teaching personnel, curriculum, instruction, methods of instruction, and materials of instruction in any school. If a State maintains separate schools for minority and for majority races, no funds made available pursuant to this Act shall be paid or disbursed to it unless a just and equitable distribution is made within the State, for the benefit of such minority races, of funds paid to it under this Act.

(d) For the purposes of this Act—

(1) "State" includes any of the forty-eight States, the District of Columbia, Hawaii, Alaska, Puerto Rico, Guam, and the Virgin Islands.[4]

(2) "State educational agency" means, as the State legislature may determine, (a) the chief State school officer (such as the State superintendent of public instruction, commissioner of education, or similar officer), or (b) a board of education controlling the State department of education; except that in the District of Columbia it shall mean the Board of Education, and except that for the period ending June 30, 1948, "State educational agency" may mean any agency or agencies within the State designated by the Governor to carry out the functions herein required of a State educational agency.

(3) "Nonprofit private school" means any private school exempt from income tax under section 101 (6) of the Internal Revenue Code, as amended.

(4) "Nonfood assistance" means equipment used on school premises in storing, preparing, or serving food for school children. (42 U. S. C. 1760)

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[4] This sentence was substituted for the original provision by the Act of July 12, 1952.

COMPROMISING, ADJUSTING, OR CANCELING DEBTS ACT OF DECEMBER 20, 1944

The Secretary of Agriculture, hereinafter referred to as the Secretary, is hereby authorized and directed to compromise, adjust, or cancel indebtedness arising from loans and payments made or credit extended to farmers under the provisions of the several Acts of Congress or programs enumerated in section 2: *Provided*, That the Secretary finds, after such investigation as he deems sufficent to establish the facts, that (1) said indebtedness has been due and payable for five years or more; (2) the debtor is unable to pay said indebtedness in full and has no reasonable prospect of being able to do so; (3) the debtor has acted in good faith in an effort to meet his obligation; and (4) the principal amount of said indebtedness is not in excess of $1,000. The Secretary is hereby further authorized at his discretion to cancel and discharge indebtedness arising under said Acts of Congress or programs when the amount of said indebtedness is less than $10, or the debtor is deceased and there is no reasonable prospect of recovering from his estate, or his whereabouts has remained unknown for two years and there is no reasonable prospect of obtaining collection, or he has been discharged of the indebtedness in any proceeding under the Act entitled "An Act to establish a uniform system of bankruptcy throughout the United States." The compromises, adjustments, or cancelations authorized by this section shall be effected through such agencies, upon such terms and conditions, and subject to such regulations, as the Secretary may prescribe, and the Secretary may delegate the exercise of any such powers and functions to such officers or employees of the Department of Agriculture as he may designate. (12 U. S. C. 1150)

Sec. 2. The provisions of this Act shall apply to any indebtedness of farmers arising from loans or payments made or credit extended to them under any of the following Acts or programs: (a) July 1, 1918 (40 Stat. 635); March 3, 1921 (41 Stat. 1347); March 20, 1922 (42 Stat. 467); April 26, 1924 (43 Stat. 110); February 25, 1927 (44 Stat. 1245); February 28, 1927 (44 Stat., part II, 1251); February 25, 1929 (45 Stat. 1306), as amended May 17, 1929 (46 Stat. 3); March 3, 1930 (46 Stat. 78–79), as amended April 24, 1930 (46 Stat. 254); December 20, 1930 (46 Stat. 1032), as amended February 14, 1931 (46 Stat. 1160); February 23, 1931 (46 Stat. 1276); January 22, 1932 (47 Stat. 5); March 3, 1932 (47 Stat. 60); February 4, 1933 (47 Stat. 795); February 23, 1934 (48 Stat. 354); June 19, 1934 (48 Stat. 1056); February 20, 1935 (49 Stat. 28); March 21, 1935 (49 Stat. 50); April 8, 1935 (49 Stat. 115) (Executive Order No. 7305); January 29, 1937 (50 Stat. 5); and February 4, 1938 (52 Stat. 27); (b) Agricultural Adjustment Act (of 1933); Bankhead Cotton Act of April 21, 1934, on account of the several cotton tax-exemption certificate pools; Jones-Connally Cattle Act of April 7, 1934; Emer-

gency Appropriation Act, fiscal year 1935, approved June 19, 1934; Kerr Tobacco Act of June 28, 1934, and Public Resolution numbered 76, approved March 14, 1936; section 32 of the Act of August 24, 1935, and related legislation; Supplemental Appropriation Act, fiscal year 1936; sections 7 to 17 of the Soil Conservation and Domestic Allotment Act; Sugar Act of 1937; sections 303 and 381 (a) of the Agricultural Adjustment Act of 1938 and related or subsequent legislation authorizing parity or price adjustment payments; title IV and title V of the Agricultural Adjustment Act of 1938 and related legislation; any amendment to any of the foregoing Acts heretofore and any other Act of Congress heretofore enacted authorizing payments to farmers under programs administered through the Agricultural Adjustment Agency; (c) Loans made by or through the Resettlement Administration or the Farm Security Administration out of funds appropriated or made available by or pursuant to the following Acts: April 8, 1935 (49 Stat. 115); June 22, 1936 (49 Stat. 1608); February 9, 1937 (50 Stat. 8); June 29, 1937 (50 Stat. 352); The Bankhead-Jones Farm Tenant Act, July 22, 1937 (50 Stat. 522 et seq.); the Water Facilities Act of August 28, 1937 (50 Stat. 869 et seq.); March 2, 1938 (52 Stat. 83, Public Resolution numbered 80); June 21, 1938 (52 Stat. 809); June 30, 1939 (53 Stat. 927); June 26, 1940 (Public Resolution numbered 88); flood-restoration loans, Second Deficiency Appropriation Act, 1943 (57 Stat. 537, 542); and subsequent legislation appropriating or making available funds for such loans; commodity loan, purchase, sale, and other programs of the Commodity Credit Corporation; and crop-insurance programs formulated pursuant to title V of the Agricultural Adjustment Act of 1938 (the Federal Crop Insurance Act), and any amendment or supplement thereto heretofore or hereafter enacted. This Act shall also apply to any indebtedness of farmers evidenced by notes or accounts receivable, title to which has been acquired in the liquidation of loans to cooperative associations made under the provisions of the Act of June 15, 1929 (46 Stat. 11). (12 U. S. C. 1150a)

SEC. 3. There is hereby authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, such amount as may be necessary to enable the Secretary to carry out the provisions of this Act, and the current and subsequent appropriations to enable the Secretary to administer the respective Acts of Congress or programs to which the aforesaid payments or loans or extensions of credit relate shall also be available for the administrative expenses of carrying out this Act. (12 U. S. C. 1150b)

SEC. 4. [Repealed, effective September 1, 1948, by 62 Stat. 862. Provisions of this section are now covered by sections 222 and 1026 of Title 18, U. S. C.]

PART VIII

DEPARTMENT OF AGRICULTURE AND FARM CREDIT ADMINISTRATION APPROPRIATION ACT, 1959 [1]

AN ACT

Making appropriations for the Department of Agriculture and Farm Credit Administration for the fiscal year ending June 30, 1959, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums are appropriated, out of any money in the Treasury not otherwise appropriated, for the Department of Agriculture and Farm Credit Administration for the fiscal year ending June 30, 1959, namely:

DEPARTMENT OF AGRICULTURE

TITLE I—REGULAR ACTIVITIES

* * * * * * *

GREAT PLAINS CONSERVATION PROGRAM

For necessary expenses to carry into effect a program of conservation in the Great Plains area, pursuant to section 16 (b) of the Soil Conservation and Domestic Allotment Act, as added by the Act of August 7, 1956 (16 U. S. C. 590p), $10,000,000 to remain available until expended.

AGRICULTURAL CONSERVATION PROGRAM

For necessary expenses to carry into effect the program authorized in sections 7 to 15, 16 (a), and 17 of the Soil Conservation and Domestic Allotment Act, approved February 29, 1936, as amended (16 U. S. C. 590g-590 (o), 590p (a), and 590q), including not to exceed $6,000 for the preparation and display of exhibits, including such displays at State, interstate, and international fairs within the United States; $235,000,000, to remain available until December 31 of the next succeeding fiscal year for compliance with the program of soil-building and soil- and water-conserving practices authorized under this head in the Department of Agriculture and Farm Credit Administration Appropriation Act, 1958, carried out during the period July 1, 1957, to December 31, 1958, inclusive: *Provided*, That not to exceed $24,698,000 of the total sum provided under this head shall be available during the current fiscal year for administrative expenses for carrying out such program, the cost of aerial photographs, however, not to be charged to such limitation; but not more than $5,025,800 shall be transferred to the appropriation account "Administrative

[1] Approved June 13, 1958, Pub. L. 85-459, 72 Stat. 188.

expenses, section 392, Agricultural Adjustment Act of 1938": *Provided further*, That none of the funds herein appropriated shall be used to pay the salaries or expenses of any regional information employees or any State information employees, but this shall not preclude the answering of inquiries or supplying of information at the county level to individual farmers: *Provided further*, That such amounts shall be available for administrative expenses in connection with the formulation and administration of the 1959 program of soil-building and soil- and water-conserving practices, under the Act of February 29, 1936, as amended (amounting to $250,000,000, including administration, and no participant shall receive more than $2,500, except where the participants from two or more farms or ranches join to carry out approved practices designed to conserve or improve the agricultural resources of the community): *Provided further*, That no change shall be made in such 1959 program which will have the effect, in any county, of restricting eligibility requirements or cost-sharing on practices included in either the 1957 or the 1958 programs, unless such change shall have been recommended by the county committee and approved by the State committee: *Provided further*, That not to exceed 5 per centum of the allocation for the 1959 agricultural conservation program for any county may, on the recommendation of such county committee and approval of the State committee, be withheld and allotted to the Soil Conservation Service for services of its technicians in formulating and carrying out the agricultural conservation program in the participating counties, and shall not be utilized by the Soil Conservation Service for any purpose other than technical and other assistance in such counties, and in addition, on the recommendation of such county committee and approval of the State committee, not to exceed 1 per centum may be made available to any other Federal, State, or local public agency for the same purpose and under the same conditions: *Provided further*, That for the 1959 program $2,500,000 shall be available for technical assistance in formulating and carrying out agricultural conservation practices and $1,000,000 shall be available for conservation practices related directly to flood prevention work in approved watersheds: *Provided further*, That such amounts shall be available for the purchase of seeds, fertilizers, lime, trees, or any other farming material, or any soil-terracing services, and making grants thereof to agricultural producers to aid them in carrying out farming practices approved by the Secretary under programs provided for herein: *Provided further*, That no part of any funds available to the Department, or any bureau, office, corporation, or other agency constituting a part of such Department, shall be used in the current fiscal year for the payment of salary or travel expenses of any person who has been convicted of violating the Act entitled "An Act to prevent pernicious political activities", approved August 2, 1939, as amended, or who has been found in accordance with the provisions of title 18, United States Code, section 1913, to have violated or attempted to violate such section which prohibits the use of Federal appropriations for the payment of personal services or other expenses designed to influence in any manner a Member of Congress to favor or oppose any legislation or appropriation by Congress except upon request of any Member or through the proper official channels.

* * * * * * *

SCHOOL LUNCH PROGRAM

For necessary expenses to carry out the provisions of the National School Lunch Act (42 U. S. C. 1751–1760), $110,000,000: *Provided*, That no part of this appropriation shall be used for nonfood assistance under section 5 of said Act: *Provided further*, That $35,000,000 shall be transferred to this appropriation from funds available under section 32 of the Act of August 24, 1935, for purchase and distribution of agricultural commodities and other foods pursuant to section 6 of the National School Lunch Act, such additional funds to be used for the general purposes of section 32.

* * * * * * *

SOIL BANK PROGRAMS

CONSERVATION RESERVE PROGRAM

For necessary expenses to carry out a conservation reserve program as authorized by subtitles B and C of the Soil Bank Act (7 U. S. C. 1831–1837 and 1802–1814), $200,000,000: *Provided*, That not to exceed $16,000,000 shall be available for administrative expenses of which not less than $12,750,000 may be transferred to the appropriation account "Local administration, section 388, Agricultural Adjustment Act of 1938": *Provided further*, That no part of this appropriation shall be used to enter into contracts with producers which together with contracts already entered into would require payments to producers (including the cost of materials and services) in excess of $375,000,000 in any calendar year, and for purposes of applying this limitation, practice payments shall be chargeable to the first year of the contract period: *Provided further*, That no part of these funds shall be paid on any contract which is illegal under the law due to the division of lands for the purpose of evading limits on annual payments to participants: *Provided further*, That hereafter no conservation reserve contract shall be entered into which provides for (1) payments for conservation practices in excess of the average rate for comparable practices under the Agricultural Conservation Program, or (2) annual rental payments in excess of 20 per cent of the value of the land placed under contract, such value to be determined without regard to physical improvements thereon or geographic location thereof. In determining the value of the land for this purpose, the county committee shall take into consideration the estimate of the landowner or operator as to the value of such land as well as his certificate as to the production history and productivity of such land.

ACREAGE RESERVE PROGRAM

For necessary expenses to carry out an acreage reserve program in accordance with the provisions of subtitles A and C of the Soil Bank Act (7 U. S. C. 1821–1824 and 1802–1814), $330,000,000: *Provided*, That not to exceed $13,000,000 of the total sum provided under this head shall be available for administrative expenses: *Provided further*, That no part of this appropriation shall be used to formulate and administer an acreage reserve program with respect to the 1959 crops.

Commodity Stabilization Service

ACREAGE ALLOTMENTS AND MARKETING QUOTAS

For necessary expenses to formulate and carry out acreage allotment and marketing quota programs pursuant to provisions of title III of the Agricultural Adjustment Act of 1938, as amended (7 U. S. C. 1301–1393), $39,715,000, of which not more than $6,380,100 shall be transferred to the appropriation account "Administrative expenses, section 392, Agricultural Adjustment Act of 1938".

SUGAR ACT PROGRAM

For necessary expenses to carry into effect the provisions of the Sugar Act of 1948 (7 U. S. C. 1101–1161), $76,000,000, to remain available until June 30 of the next succeeding fiscal year: *Provided*, That expenditures (including transfers) from this appropriation for other than payments to sugar producers shall not exceed $2,124,500.

Federal Crop Insurance Corporation

OPERATING AND ADMINISTRATIVE EXPENSES

For operating and administrative expenses, $6,376,700.

* * * * * * *

TITLE II—CORPORATIONS

The following corporations and agencies are hereby authorized to make such expenditures, within the limits of funds and borrowing authority available to each such corporation or agency and in accord with law, and to make such contracts and commitments without regard to fiscal year limitations as provided by section 104 of the Goverment Corporation Control Act, as amended, as may be necessary in carrying out the programs set forth in the budget for the fiscal year 1959 for such corporation or agency, except as hereinafter provided:

Federal Crop Insurance Corporation Fund

Not to exceed $2,000,000 of administrative and operating expenses may be paid from premium income.

Commodity Credit Corporation

RESTORATION OF CAPITAL IMPAIRMENT

To restore the capital impairment of the Commodity Credit Corporation determined by the appraisal of June 30, 1957, pursuant to section 1 of the Act of March 8, 1938, as amended (15 U. S. C. 713a–1), $1,760,399,886.

LIMITATION ON ADMINISTRATIVE EXPENSES

Nothing in this Act shall be so construed as to prevent the Commodity Credit Corporation from carrying out any activity or any

program authorized by law: *Provided*, That not to exceed $35,398,000 shall be available for administrative expenses of the Corporation: *Provided further*, That $1,000,000 of this authorization shall be available only to expand and strengthen the sales program of the Corporation pursuant to authority contained in the Corporation's charter: *Provided further*, That not less than 7 per centum of this authorization shall be placed in reserve to be apportioned pursuant to section 3679 of the Revised Statutes, as amended, for use only in such amounts and at such time as may become necessary to carry out program operations: *Provided further*, That all necessary expenses (including legal and special services performed on a contract or fee basis, but not including other personal services) in connection with the acquisition, operation, maintenance, improvement, or disposition of any real or personal property belonging to the Corporation or in which it has an interest, including expenses of collections of pledged collateral, shall be considered an nonadministrative expenses for the purposes hereof.

* * * * * * *

TITLE IV—GENERAL PROVISIONS

SEC. 401. Within the unit limit of cost fixed by law, appropriations and authorizations made for the Department under this Act shall be available for the purchase, in addition to those specifically provided for, of not to exceed 466 passenger motor vehicles of which 462 shall be for replacement only, and for the hire of such vehicles.

SEC. 402. Provisions of law prohibiting or restricting the employment of aliens shall not apply to employment under the appropriation for the Foreign Agricultural Service.

SEC. 403. Funds available to the Department of Agriculture shall be available for uniforms or allowances therefor as authorized by the Act of September 1, 1954, as amended (5 U. S. C. 2131).

SEC. 404. No part of the funds appropriated by this Act shall be used for the payment of any officer or employee of the Department who, as such officer or employee, or on behalf of the Department or any division, commission, or bureau thereof, issues, or causes to be issued, any prediction, oral or written, or forecast, except as to damage threatened or caused by insects and pests, with respect to future prices of cotton or the trend of same.

SEC. 405. Except to provide materials required in or incident to research or experimental work where no suitable domestic product is available, no part of the funds appropriated by this Act shall be expended in the purchase of twine manufactured from commodities or materials produced outside of the United States.

SEC. 406. Not less than $1,500,000 of the appropriations of the Department for research and service work authorized by the Acts of August 14, 1946, and July 28, 1954 (7 U. S. C. 427, 1621–1629), shall be available for contracting in accordance with said Acts.

SEC. 407. No part of any appropriation contained in this Act or of the funds available for expenditure by any corporation or agency included in this Act shall be used for publicity or propaganda purposes to support or defeat legislation pending before the Congress.

This Act may be cited as the "Department of Agriculture and Farm Credit Administration Appropriation Act, 1959".

INDEX

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The COLD STORAGE OF VINIFERA TABLE GRAPES

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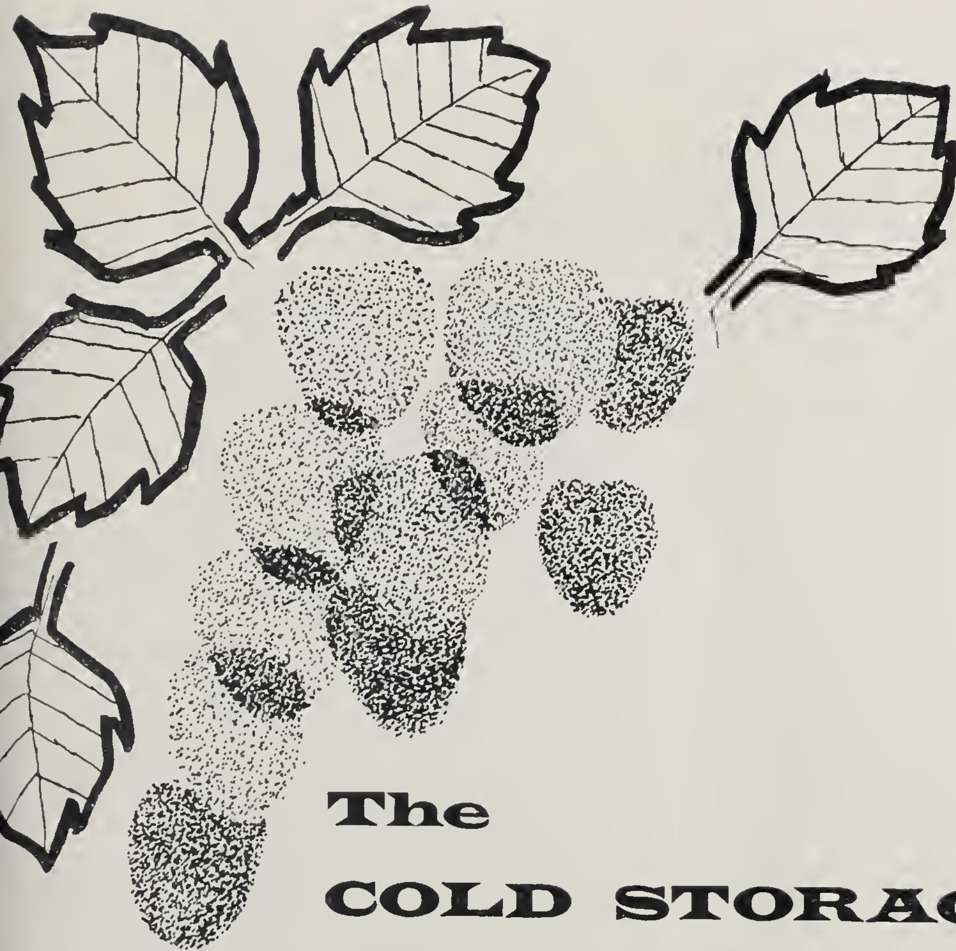

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AGRICULTURAL MARKETING SERVICE

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CONTENTS

THE COLD STORAGE OF VINIFERA TABLE GRAPES

A. Lloyd Ryall and John M. Harvey[1]

Introduction

This handbook brings together the accumulation of 30 years of research and experience in grape storage. It is written for operators of storage plants, growers, packers, and buyers of fresh grapes. The information presented on temperature, humidity, air movement, storage design, fumigation, and storage disorders, together with the sources of such information, can be used to maintain quality, reduce spoilage, and improve marketing of grapes.

Although European-type table grapes (*Vitis vinifera* L.) have been produced commercially in California since 1860, (*36, 64*)[2] prolonged storage dates back only to the late 1920's when methods for periodic fumigation with sulfur dioxide were developed. Before this some table grapes were packed in ground cork or sawdust and were stored for only 4 to 6 weks, mostly at terminal markets (*70*). With further development and refinement of fumigation methods, the extensive storage of grapes in display lugs became possible and increasing quantities were stored in the producing areas for distribution during the winter and spring months.

The holdings of table grapes in California during 4 representative storage seasons from 1935 to 1955 are shown in figure 1. During this period table grape production was fairly constant and yet, as the figure shows, both the quantity of fruit stored in California and the

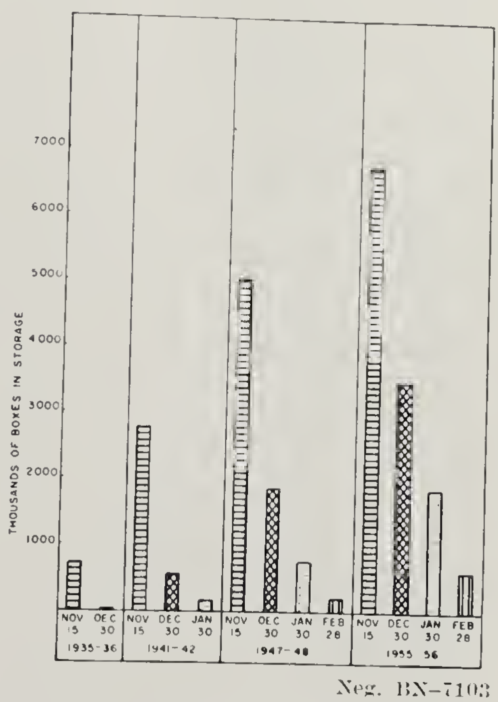

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Figure 1.—Cold storage holdings of table grapes in California during four seasons. Data from annual summaries of Federal-State Market News Service.

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[2] Italicized numbers in parenthesis refer to items in Literature Cited, p. 41.

period during which it was stored increased materially. During 1956 grapes were stored in about 95 cold storages in California, many of which, particularly in the San Joaquin and Sacramento Valleys, are designed principally for table grapes. On November 15, 1955, about 6,500 carlots of table grapes were in Central Valley storages.

Factors Affecting Quality of Stored Table Grapes

Each of the characters that contribute to dessert quality, such as flavor, color, and texture, is at a peak when grapes are harvested at optimum maturity. Changes that occur thereafter, even under ideal holding conditions, involve a gradual deterioration of these qualities. It is thus apparent that good quality after storage depends primarily on placing fruit of good quality into storage.

Maturity

The determination of optimum maturity of table grapes to be stored should be based on such qualities as berry and stem color, sugar content, acidity, and development of flavor characteristic of the variety. Minimum legal maturity for shipment under California law is based almost entirely on soluble solids as determined by juice readings with the Balling hydrometer or hand refractometer. However, Winkler (*76*) found that the ratio of soluble solids to percent acidity of the expressed juice was a better index of dessert quality than soluble solids alone and suggested Balling-acid ratios for table varieties that were above the legal minimum but below 20 percent soluble solids. Grapes with 20 percent or more soluble solids were considered to have good dessert quality at any acidity level.

As grapes mature the stems change from a leaf-green to a light green or straw color, and in some varieties a woody portion resembling the cane forms at the base of the stem. These changes are indicative of good storage quality, for matured stems are less subject to desiccation, breakage, discoloration, and mold attack than immature ones. In addition, well matured stems are usually indicative of well matured and colored berries. The sturdy cap stems (pedicels) characteristic of matured stems reduce the shatter of berries from the cluster.

Handling Before and During Storage

Precooling

The value of prompt and thorough removal of field heat from grapes intended for immediate shipment or storage has been demonstrated repeatedly in both controlled tests and industry experience. Fruit should not only be promptly cooled after packing, but unnecessary delays in the vineyard and packing house before trimming and packing should be avoided. Delays at high temperature between harvest and the start of precooling are certain to result in undesirable stem drying, berry shrivel, shatter, and infection by decay organisms (*42*).

Relation to Moisture Loss From Fruit

Loss of water from any product is governed largely by the protective surface of the commodity, the amount of air moving over it, and the difference in vapor pressure between the commodity and the air. Grape berries have a relatively impervious skin so they do not give up water readily, and consequently

moisture is lost largely through the stems.

Air movement may vary from moderate in the vineyard to high velocity during precooling. The principal factor involved in moisture loss, however, is vapor pressure differential. For example, if we assume that air in the intercellular spaces is nearly saturated with water vapor, the tissues at 80° F. would have a vapor pressure equivalent to .99 inch of mercury. It would be somewhat less than this because of the sugar content of the fruit, but these figures are valid for comparative purposes. Air at 80° with 20 percent relative humidity (RH) would have a vapor pressure of only 0.21 inch. At 90° the tissues would have a vapor pressure of about 1.3 while air at 90° with 22 percent RH would have a vapor pressure of 0.30. These large differences in vapor pressure would result in relatively rapid movement of moisture from the tissues to the air and are representative of actual conditions that might occur in the vineyard or packing house after picking.

Differences in vapor pressure also occur during precooling because low temperature air has a much lower vapor pressure than high temperature fruit (table 1). For example, air at 31° F. and 94.3 percent RH has a vapor pressure of 0.164 inch whereas grapes at 80° have a vapor pressure of about 0.99. From these figures it is apparent that the faster grapes can be lowered to the temperature of the air in the precooling chamber the less moisture will be lost. The figures in table 1 also demonstrate that maintaining high atmospheric humidity during precooling is not as important as fast cooling. To illustrate this fact, observe that the difference in vapor pressure of 31° air at 94.3 percent RH and 79.5 percent RH is insignificant as compared with the vapor pressure of fruit at higher temperatures. This principle was demonstrated by Dewey (*15*) in a study of moisture-loss from cherry and grape stems. He found that significantly more water was lost from sweet cherry stems cooled in still air at 90 percent RH than in an air blast at 70 percent RH. The amount of cooling that took place in 1 hour in an air blast required over 7 hours in still air. Consequently, the difference in moisture-loss was due primarily to the rapid decrease in vapor pressure differential when subjected to air blast cooling.

TABLE 1.—*Relation of air temperature and relative humidity to vapor pressure*

Air temperature (dry bulb)	Depression of wet bulb	Relative humidity	Vapor pressure (Hg)
°F.	*°F.*	*Percent*	*Inches*
31	0.5	94.3	0.164
31	2.0	79.5	.136
32	.5	94.4	.172
32	2.0	80.0	.143
33	.5	94.5	.180
33	2.0	80.5	.150
34	.5	94.6	.187
34	2.0	81.0	.157
35	1.0	90.0	.187
40	1.0	92.0	.228
50	.5	96.0	.347
60	.5	97.0	.499
70	.5	98.0	.707
80	.5	98.0	.989
80	23.0	20.0	.322
90	1.0	96.0	1.364
90	22.0	31.0	.432
90	29.0	15.0	.211

Factors Affecting Rate of Precooling

The rate of cooling of any commodity is primarily dependent upon four factors: (1) The accessibility of the product to the refrigerating medium, (2) the difference in temperature between the product and the refrigerating medium, (3) the velocity of the refrigerating me-

dium, and (4) the kind of cooling medium. Since air is the refrigerating medium used in grape cooling to obtain optimum cooling, (1) the product must be packaged and stowed in such a way that air will reach all packages of fruit uniformly, (2) the temperature of the air must be maintained continuously at a point slightly above that at which the product freezes, and (3) the air must be moved rapidly over, or preferably through, the containers.

Effect of packaging.—Accessibility of the product to the cooling medium is one of the factors governing the rate of cooling. Since the type of package and the materials used in the package affect accessibility, they become factors in the cooling rate. Pentzer (*50*) reported that grapes packed in sawdust cooled at about half the rate of grapes in the display lug. He also showed that cellophane curtains over the face of the pack considerably reduced the cooling rate over that in lugs without curtains. However, this difference in cooling rate occurred only when both types of pack were exposed to circulating air. In parts of the load where cooling was principally by conduction the curtains had little effect. Ryall (*62*) reported that, under standardized conditions of air movement, the cooling rate in standard display lugs was affected by placement of the side slats, and that either side liners or curtains reduced the cooling rate as compared with lugs packed with bottom pads only. When the grapes can be stored under ideal conditions after precooling (about 90 percent RH and minimum air movement for the maintenance of uniform temperatures), packaging materials, other than bottom pads, are of questionable value. Their elimination would reduce packing costs and speed precooling. However, when grapes are stored under lower than recommended humidities or excessive air movement, such materials as side liners or curtains may be justified for the reduction of stem drying and berry shrivel.

Types of Precooling

Room precooling.—Many of the table grapes going into cold storage are precooled in special rooms that have more refrigerating capacity and greater air volume than the regular rooms in which the grapes are stored. These rooms are generally rather small with capacities of from 1,000 to 5,000 lugs, so that they can be filled rather rapidly and operated without interruption during the cooling period. Since it requires approximately 4 tons of refrigeration to cool 1,000 lugs of grapes 40°, a room that holds 2,000 lugs with capacity to reduce this load 40° in 12 hours must be equipped to provide 16 tons of refrigeration in 24 hours. Additionally, it should have fans or blowers capable of producing 6,000 to 8,000 cubic feet per minute (cfm) of air per 1,000 lugs of fruit and air directing or distributing devices that will provide an even flow of air in all parts of the room.

Figure 2 shows a dry-coil bunker precooling room with 2 of the baffles removed to show the coils. The 2 fans pull air over the refrigerating coils (7,900 feet of 1¼-inch ammonia coil) and move it through a duct on the ceiling to the back of the room where it is released. The air returns through the palletized stacks to the bottom opening of the coil bunker. The room has a capacity of 5,200 standard display lugs (28 pounds net) and the 2 blowers move air at 34,600 c.f.m. This is an excellent type of precooling room with ample refrigeration and good air volume and distribution.

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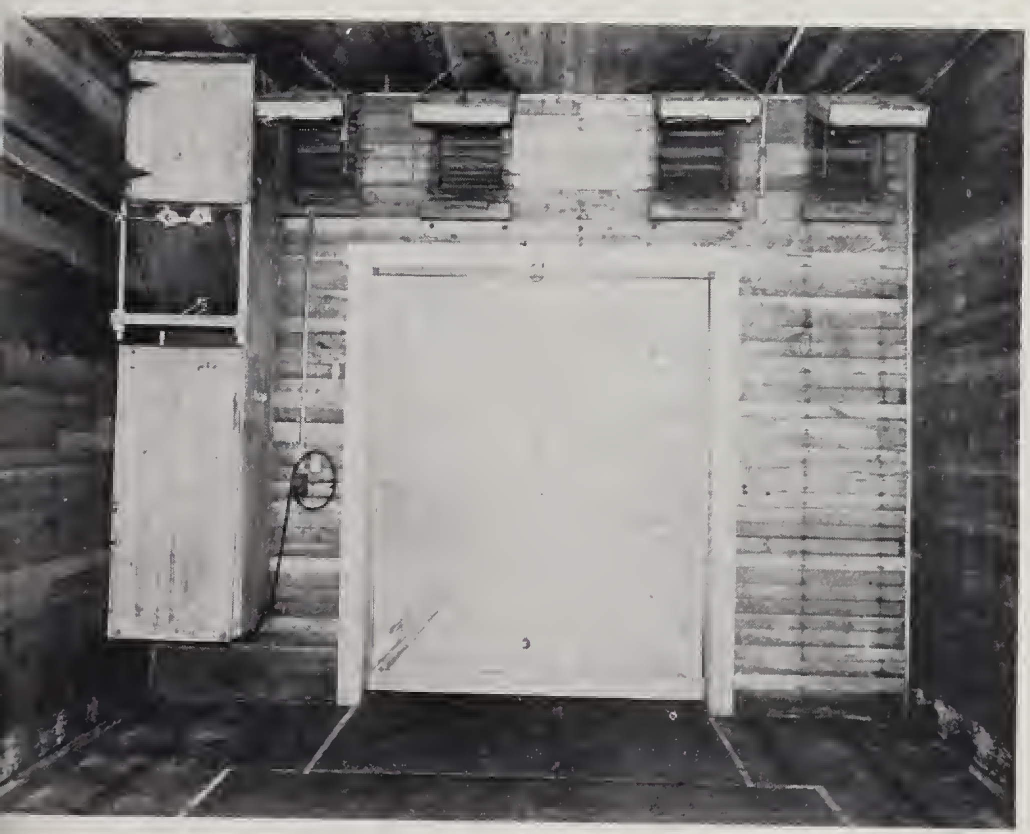
Figure 2.—Face of dry coil bunker (2 panels removed) and ducts from two fans. Five-car precooling room.

A precooling room refrigerated by a central brine spray unit is shown in figure 3. Air is ducted from the spray unit to the back end of the room and passes into a return duct through the openings shown at the front. The room has a capacity of 2,200 hand-stacked lugs. Additional air as needed can be diverted from the main supply duct. The vertical flue in one corner is used to circulate sulfur dioxide during fumigation which, at the completion of gassing, can be cleared from the room by manipulation of the louver.

An ice-refrigerated precooling room with a capacity of 6,600 lugs in one layer of pallets is shown in figure 4. Six fans, each with a rated capacity of 8,000 c.f.m., are located at the top of the bulkhead in the far end of the room. These



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igure 3.—A 2,000-lug precooling room with air ducted from central brine spray chamber—opening to return duct and SO_2 circulating flue shown.

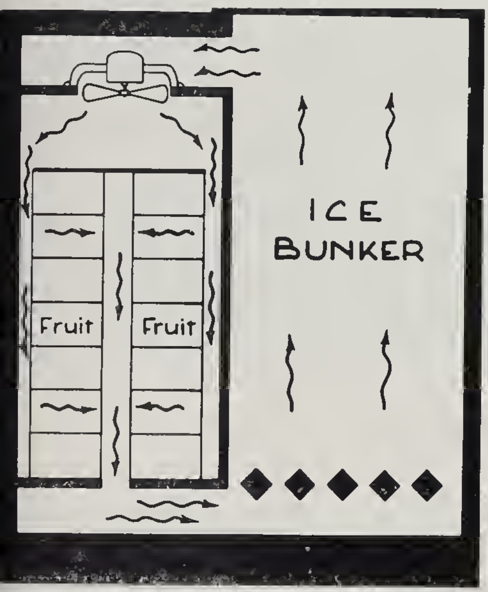
Figure 4.—Ice-refrigerated precooling room showing false ceiling for ducting air from six fans and canvas baffles for directing air through palletized stocks of fruit.

pull air from an ice bunker located below the loading platform outside the building, move the air through the false ceiling duct, and discharge it near the rear of the room. When the room is operating, the canvas baffles suspended from the duct are lowered to the top of the load to assure movement of the return air through the stacked fruit rather than over the top of the load. The bunker has a capacity of about 30 tons of chunk ice to which salt can be added if a lower temperature air blast is desired. In actual operation the generous air volume and large ice capacity of this system have provided a satisfactory rate of cooling without the use of salt.

Car precooling.—Grapes intended for storage are not ordinarily precooled in refrigerator cars. However, when grapes move some distance to a cold storage plant from points where other precooling facilities are not available, very satisfactory removal of field heat can be accomplished in a refrigerator car. In this case the refrigeration is supplied by ice in the car bunkers and the air movement is provided by either the built-in car fans or portable bulkhead fans. The refrigerator car thus becomes essentially a precooling room and the same principles of air volume, air direction, and temperature differential apply. The fruit must be loaded to provide free air access to all parts of the load, the bunkers must be kept adequately supplied with ice, and salt must be added to the ice in sufficient amount to maintain a consistently low air blast temperature.

Forced air precooling.—A method of rapid cooling, based on fore-

ing air through vented containers by creating a pressure differential, has been developed by the Department of Agricultural Engineering at the University of California (*25*). It has been reported that commodities packed in containers that allow free air flow through the package, and in stacks spaced and baffled so that air supplied by the fans must pass through the packages, can be cooled in one-eighth the time required by the conventional method of passing air over the outer surfaces of the packages (fig. 5).



Forced-Air Fruit Cooler
Diagrammatic Section

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Figure 5.—Principle of forced-air cooling. (Photograph courtesy of Rene Guillou, Department of Agricultural Engineering, University of California, Davis, Calif.)

Other adaptations of this principle can and have been successfully made in existing precooling rooms and in refrigerator cars. However, it should be remembered that the system is ineffective with any pack that does not permit air passage, such as a wrap pack or sawdust pack, and it becomes less effective as resistance within the package is increased by packaging materials such as side liners, curtains, trays, or cups.

Tunnel cooling.—Tunnel cooling has been used for several years in the early grape districts (*1*) for the rapid removal of field heat from packed grapes. The method allows the loading and shipment of precooled grapes on the day of harvest whereas conventional cooling methods require holding the fruit over a day to accomplish comparable cooling. However, tunnel cooling also has been used for rapid precooling prior to refrigerated storage. The cooling is accomplished by moving the packed, unlidded lugs on a continuous conveyor under a plenum chamber from which high-velocity, refrigerated air is directed at the face of the lugs from slots on the lower face of the plenum. The refrigeration source through which the air circulates is either ice or a mechanically refrigerated evaporator coil. Some of the units are designed to move a single layer of lugs directly under the plenum whereas others use multiple layer conveyors with baffles beneath each row of lugs to redirect the air at the face of the lugs below. The single layer coolers have produced somewhat more rapid and uniform cooling than the multiple layer coolers. Figure 6 illustrates the loading end of a multiple layer cooler operated in the Coachella Valley.

Vacuum cooling.—The cooling of certain kinds of fresh produce by evaporation of moisture at reduced pressures obtainable in a vacuum chamber has developed into extensive commercial use within the last 8 years. However, the process is adapted principally to those commodities, such as leafy vegetables, that have a relatively large surface area in proportion to volume. The amount of heat that can be removed by this process is limited by the amount of water than can be vaporized from the tissues without

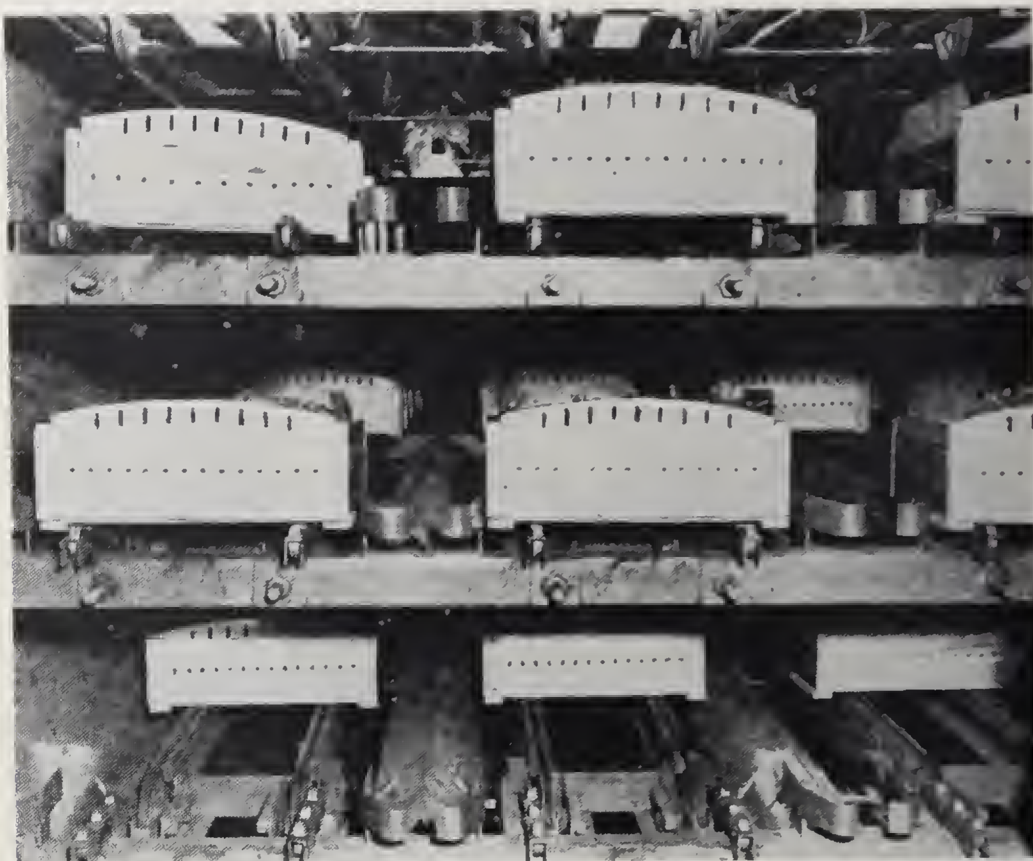

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Figure 6.—Multiple-layer tunnel cooler. (Photograph courtesy of California Fruit Exchange, Sacramento, Calif.)

damage to the texture or appearance of the product.

Tests conducted at Fresno and New York (*24*) have shown individual grape berry temperature reductions of only 6° to 10° by the standard treatment used for leafy vegetables. W. R. Barger of the U.S. Department of Agriculture (unpublished data) determined that moisture loss from grape clusters was only 0.4 to 0.5 percent when pressure in the chamber was reduced to 4.5 mm. of mercury and maintained for 10 minutes. Cooling from 70° to 35° F. would require evaporation of water equivalent to approximately 2.5 percent of the original fresh weight of the fruit. If it were possible to withdraw this amount of moisture the appearance of the clusters would probably be adversely affected. It seems apparent, therefore, that grapes are not adapted to vacuum cooling.

Storage Environment

After sound, mature grapes have been properly packaged and precooled, the factor which then determines success or failure in their preservation is the storage environment. Factors in the environment that affect grape quality are temperature, atmospheric humidity, air movement, and fumigation with sulfur dioxide.

Temperature

Although one study (*12*) indicated that Emperor grapes could be stored at temperatures as low as 28.4° F., present recommendations are generally for air temperatures

of 30° to 31°. The freezing point of seven varieties of California-grown vinifera grapes has been reported to vary from an average of 23.6° and a range of from 22.9° to 24.7° for mature Thompson Seedless, to an average of 25.6° and a range of from 25.2° to 26.1° for mature Almeria (*78*). Since the freezing point is largely determined by sugar content, certain lots that are harvested at minimum maturity may have freezing points as high as 27°. While there appears to be no evidence on the freezing point of grape stems, it seems probable that they may freeze at a slightly higher temperature than the berries. To provide a margin of safety in relation to freezing, allowance must be made for temperature variation because of the lag in response to refrigeration controls and the temperature spread between incoming and return air.

Relative Humidity

A numerical figure for relative humidity represents the percent of saturation of air with water vapor at a given temperature. The water holding capacity of air increases as the temperature rises so air of 90 percent relative humidity at 70° F. contains much more water by weight than air of the same relative humidity at 32°. As the relative humidity of air increases the vapor pressure also increases and the capacity of the air for removing water from other sources decreases.

It is thus apparent that to reduce moisture loss from stored fruit to a minimum, the relative humidity of the storage air must approach that of the air within the intercellular spaces of the individual fruits. Assuming that air in the intercellular spaces is saturated and that the fruit and storage air temperatures are identical, moisture loss from the fruit could be entirely stopped only by maintaining the storage air at a relative humidity of 100 percent. However, this is not possible under commercial conditions and would not be desirable if it could be accomplished because saturated air would favor the rapid development of decay organisms. Actually, the relatively small vapor pressure differential between fruit at 32° F. and air at 31° with 90 percent RH results in only slight moisture loss from the product. Such slight losses are within the limits of commercial acceptibility during a normal storage period, particularly if air movement is not excessive. It has been determined that grapes can lose as much as 1.2 percent water by weight without affecting their appearance and that moisture losses as high as 5 to 6 percent were required to cause severe shriveling (*46*).

The best and currently recommended relative humidity for the cold storage of vinifera grapes is 87 to 92 percent (*3*). Earlier recommendations were usually in the range of 85 to 90 percent, but as methods of decay control have been improved the use of higher humidities, as a means of maintaining better appearance, has been recommended and rather generally accepted.

Accurate control of refrigerant temperature provides the only satisfactory method for maintaining high humidities in mechanically refrigerated storages. As the difference between the temperature of the refrigerating surface (coil or spray) and the temperature of the air in contact with the refrigerating surface increases, the humidity decreases. If the temperature of the refrigerating surface is below the dew point at a given air temperature and relative humidity, then moisture will condense on this surface and the air will lose moisture equivalent to the amount condensed.

The data in table 2 indicate the relative humidity that could be expected with certain air and refrigerating surface temperatures. For example, if the air moving over the refrigerating surface is cooled to 30° F. and the surface temperature is 25°, the relative humidity of this air will be about 79 percent because any water vapor above this amount will condense on the coil or spray. However, if air at the same temperature moves over a refrigerating surface maintained at 27° the relative humidity will be almost 89 percent and if the difference between air and refrigerant temperature were only 1° (air 30°, refrigerant 29°) then a relative humidity of over 94 percent could be expected. Actual humidities obtained under the above conditions of refrigerant and air temperatures will usually be somewhat higher than indicated because all of the air will not come in contact with the refrigerating surface. Thus air leaving the chamber will be a blend of that which has dropped moisture and that which has retained its original moisture content.

It is, of course, apparent that as the split between refrigerant temperature and air temperature becomes narrower, a greater refrigerating surface is necessary. If air is cooled from 32° to 30° F. during passage through a dry coil bunker, considerably more surface will be required to accomplish this temperature reduction when the coil is operated at 29° than when it is operated at 25°. This principle has been recognized in most of the newer grape storage plants. With an adequate refrigerating surface and with the temperature of that surface controlled by automatic devices, there is no humidity problem. Where refrigerant surface is not adequate to maintain the desired atmospheric humidity, pressure-atomized or heat-vaporized water can be added to the air. However, this is a makeshift which will materially add to coil frosting or brine dilution problems.

TABLE 2.—*Relation of dew point to air temperature and relative humidity*

Dew point	Air temperature (dry bulb)	Depression of wet bulb	Relative humidity
° F	*° F.*	*° F.*	*Percent*
28	29	0.5	94.4
26	29	1.0	88.3
23	29	2.0	78.5
29	30	0.5	94.2
27	30	1.0	88.6
25	30	2.0	79.0
30	31	0.5	94.3
28	31	1.0	89.0
26	31	2.0	79.5
31	32	0.5	94.4
30	32	1.0	89.2
27	32	2.0	80.0
31	33	1.0	89.5
32	34	1.0	89.7
33	35	1.0	90.0

In ice-refrigerated storage rooms the temperature of the refrigerant is 32° F. unless salt is added to the ice. Air temperatures in well designed ice-refrigerated storages usually can be maintained at about 34° after the fruit is thoroughly cooled. With a refrigerant temperature of 32° this would indicate a relative humidity of about 90 percent which is well within the desirable range. As with mechanically refrigerated rooms the amount of refrigerating surface is important and if 34° air is to be maintained, with melting ice at 32° as the refrigerant, an ice bunker large enough to permit a large ice surface must be provided.

Air Movement

As indicated in an earlier section, to provide uniform high velocity air through the stacks, a minimum air volume of 6,000 c.f.m. per 1,000 lugs is essential for the rapid re-

moval of field heat. This is best accomplished in a separate precooling room that has more refrigerating and air moving capacity than that required in a regular holding room.

After the field heat has been removed from the fruit, a high air velocity is unnecessary and undesirable. Only enough air movement should be provided to remove respiratory heat and heat entering the room through exterior surfaces and doorways. Usually 50 to 75 linear feet per minute (lfm) through the stacks is sufficient to accomplish this, but it is very important that the air is directed in such a way that it moves uniformly through all parts of the room. Allen and Pentzer (2) found that doubling the air movement in fruit storage rooms increased moisture loss by about onethird and was equivalent to about a 5 percent drop in relative humidity.

Methods of controlling air movement.—All modern grape storage rooms have fans or blowers to provide forced air circulation. The rooms, with individual dry-coil, spray-coil, or ice bunkers, provide air movement by means of blade fans mounted along the upper part of the bunker. These may move air directly across the upper part of the room from open fans (fig. 7) or through ducts which extend part way or entirely across the ceiling to discharge air against or down the opposite wall (fig. 8). Somewhat more positive and uniform air movement is obtained when the air is ducted across the room to return through the stacked fruit than when open fans are used. With the latter there is a tendency for part of the air to short-circuit back to the bunker.

Many methods of air circulation are used within rooms which are cooled by a ducted system from a central brine-spray chamber. A common system for distributing air in the narrower rooms is shown in figure 9. Each long wall of the room contains an air duct. The air from the brine spray chamber is discharged through the louvered openings at the lower part of the right wall, moves through the stacked fruit and enters the return duct through openings located along the wall and near the ceiling at the left. If the openings are properly adjusted to effect uniform air flow from the discharge side, this system provides very uniform and satisfactory air movement.

In wider rooms multiple ducts are often used. The air is discharged from several ducts and moves in a predetermined pattern to one or more return ducts. Figure 10 shows a grape storage room in which the air from the central brine spray chamber is discharged downward from a duct on each side wall, moves through the stacks to the center of the room, and enters the return duct through openings at the bottom and upper sides. This provides excellent air distribution as determined by the uniformity of air velocity and temperature through the room.

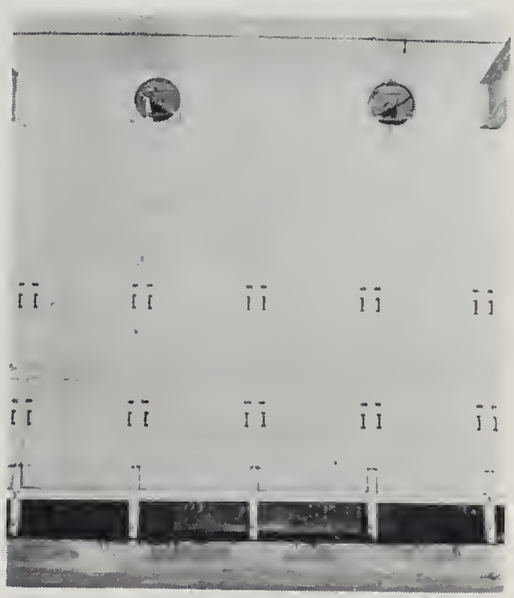

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Figure 7.—Open fan at the top of a dry-coil bunker.

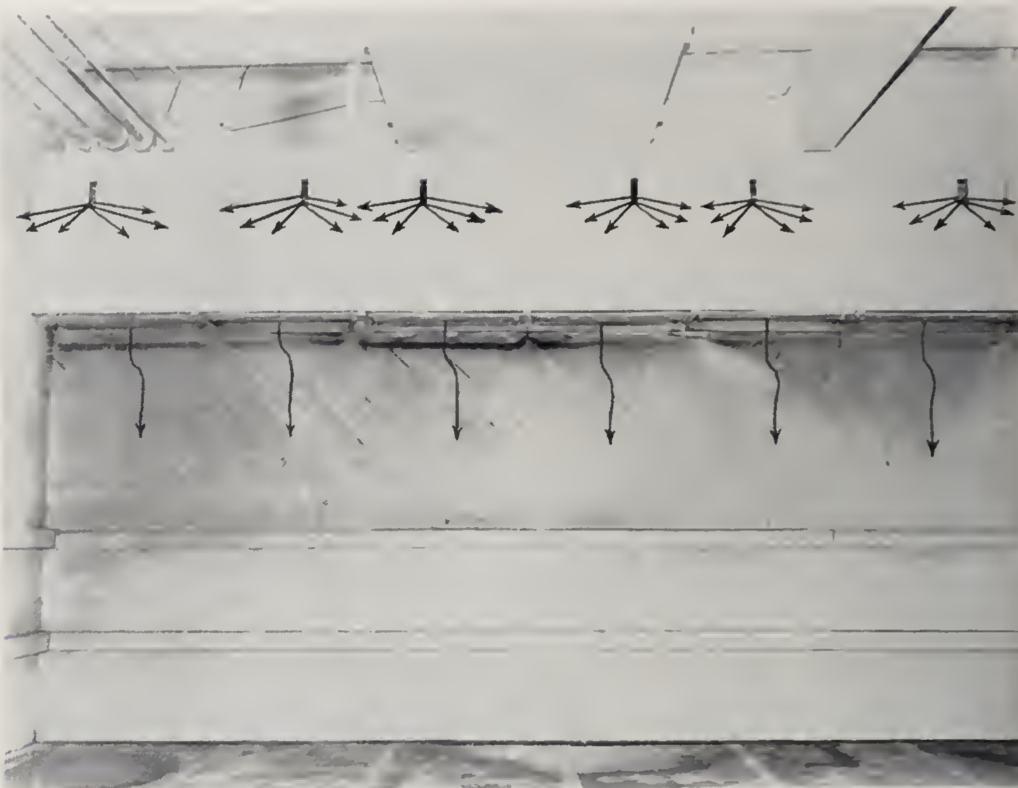

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Figure 8.—Rear wall discharge of air from ceiling ducts in room dry-coil bunker system. Air moves straight down from bottom duct openings and straight out from front duct openings.

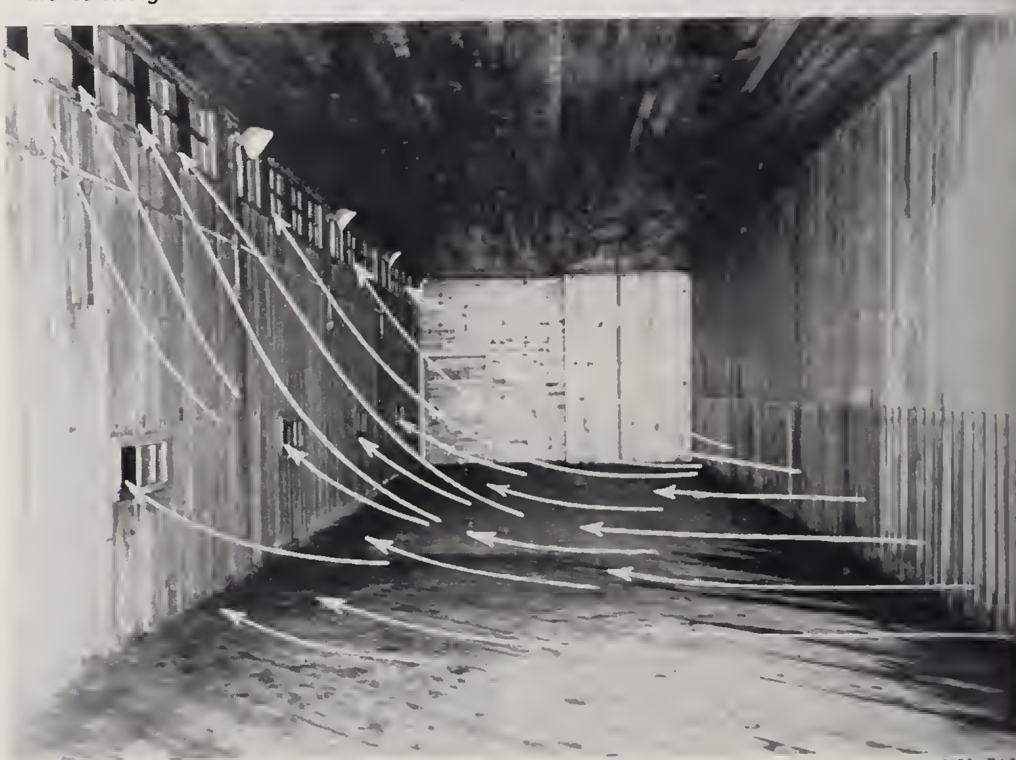

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Figure 9.—Cross-room air movement from wall ducts supplied by central brine-spray chamber. Air moves across room from louvered openings at right to upper and lower openings at left.

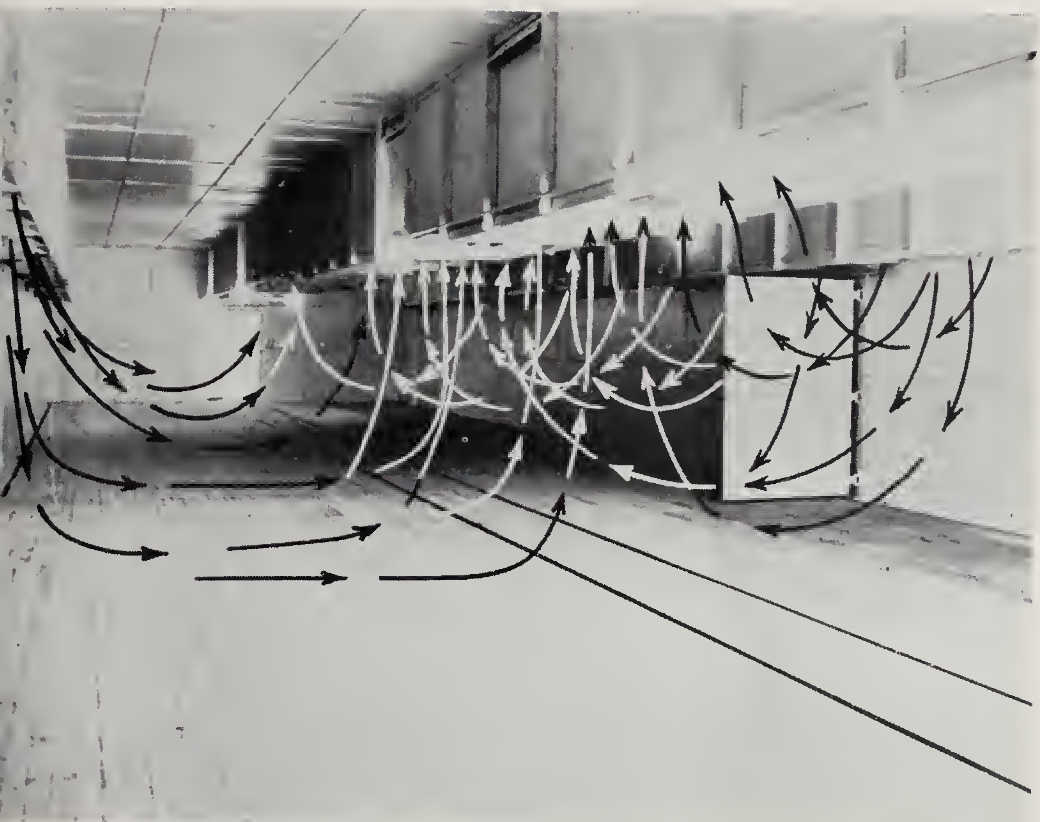

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Figure 10.—Storage room with air discharge ducts at side walls and return duct in center. Air moves down from bottom of side wall ducts and up into bottom and sides of ducts down center of room.

Effect of stacking method on air movement.—Air distribution and fruit temperature are both materially affected by placement and alignment of the stacked packages of fruit. Most of the newer plants stack on pallets with the pallet loads placed 3 high in the storage rooms. Whether the containers are palletized or hand stacked in the rooms, 2 principles should be observed: (1) The side of the display lugs should be in the direction of air movement; and (2) uniform spacing should be maintained between rows and between pallets. Heat transfer is accomplished much more easily from the lightweight, partially open side of the lug than from the thick, solid end pieces; and uniform spacing of rows and pallets is essential for good air distribution.

A cardinal principle of air movement is that air will follow the path of least resistance and, if spacing is irregular, the wider spaces will get a greater volume of air than the narrower ones. If some spaces are partially blocked, dead air zones will occur with resultant temperature rises or localized failure of sulfur dioxide to reach these spots during fumigation. Wide aisles in the direction of air movement are undesirable since most of the air will move through the aisle and will by-pass the stacked fruit. If two-way pallets are used the pallets can be stacked in either direction, but when one-way pallets are used the open ends should always be in the direction of air movement. Figures 11 and 12 illustrate excellent stacking arrangements for

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Figure 11.—Palletized stacks on two-way pallets with sides of lugs in direction of air movement.

palletized fruit. Figure 11 shows fruit on two-way pallets with good spacing between rows on the pallets and between pallets. Air is discharged from the duct at the back of the room and moves forward to the coil-bunker through the stacks. This room was being emptied when the photograph was made, but is completely filled during most of the storage season with an aisle only along the coil-bunker side of the end crosswise of the air movement. Figure 12 shows the face of palletized stacks in a coil-bunker room with open fans. Air from the fans moves over the top of the stacks and returns through the stacks to the bottom bunker opening. These are one-way pallets with the open ends in the direction of air movement. Note the uniform spacing of lugs and pallets and the excellent alignment.

Types of Refrigeration Systems

Many cold storage plants in Central California were designed and built specifically for the storage of table grapes. In these plants, four general types of refrigerating systems exist: (1) Individual room dry-coil bunkers; (2) individual room unit coolers; (3) central brine-spray chambers with ducted-air systems; and (4) individual room ice bunkers. There are however, many minor variations within these basic types.

Dry-Coil Bunkers

Most cold storages built in recent years and intended primarily for table grapes are of the individual room, dry-coil bunker type. Direct-expansion coils of smooth pipe

(usually $1\frac{1}{2}$ to 2 inch) are mounted on one wall of the room and a wooden baffle is constructed between the bank of coils and the room. Openings at the top and bottom of the baffle allow air to circulate over the coils. Fans in the upper openings draw the air in at the bottom opening; the air moves over the refrigerating surface on the coil bank and through the fans to ceiling ducts or directly into the space above the stacked produce.

It is customary to place the coil bunker on the long-dimension wall. If the room is not over 40 feet wide, open fans at the top of the baffle generally provide satisfactory air distribution. If the air must be moved more than 40 feet, better air distribution is obtained by moving the air through ducts part or all the way across the room.

This system is particularly well adapted to grape storages because grapes must be treated periodically with sulfur dioxide and the individual room bunker permits each room to be treated as a separate unit. Since sulfur dioxide is rather corrosive to metals, smooth pipe rather than finned coils are used. The coil surfaces are often coated with corrosion-resistant paints, and some method of bypassing the coil during sulfur dioxide fumigation is commonly provided. Figure 13 shows a section of dry-coil bunker during normal refrigeration operation with the louvers at the bottom of the baffle open for air circulation through the coil bank. The same section is shown in figure 14, but with the bottom louvers closed and the hinged door near the fan housing open. This permits cir-

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Figure 12.—Palletized stacks on one-way pallets. Air movement along sides of lugs and open pallets.

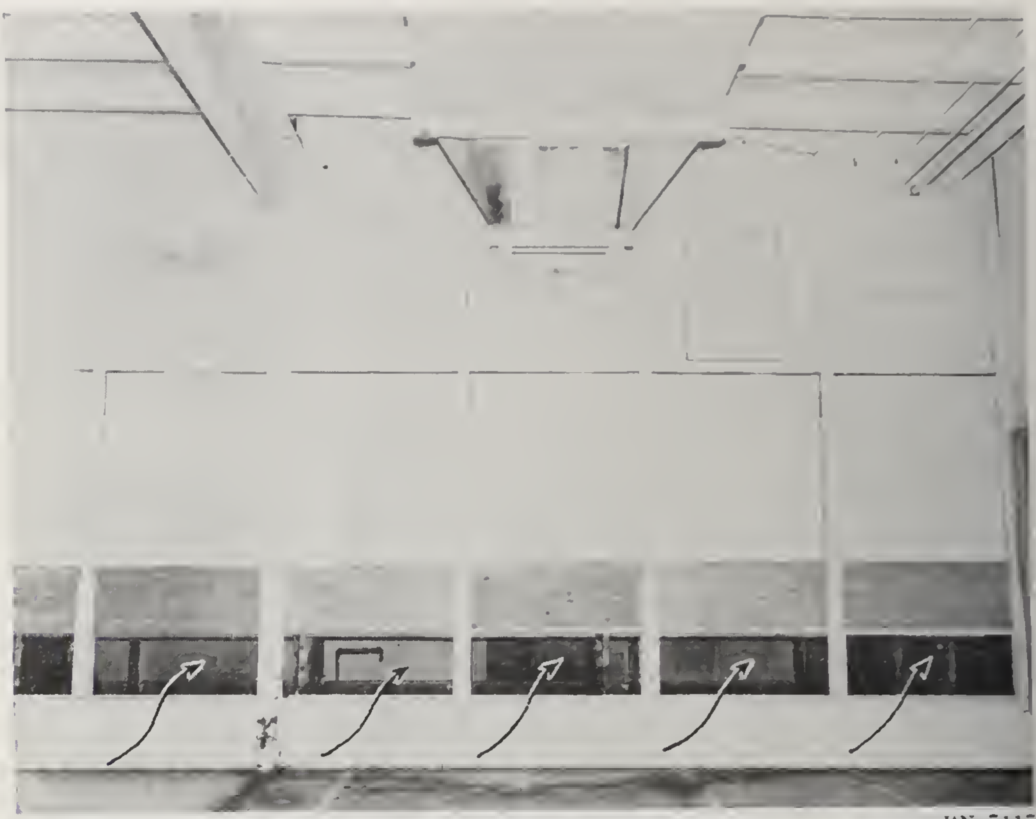
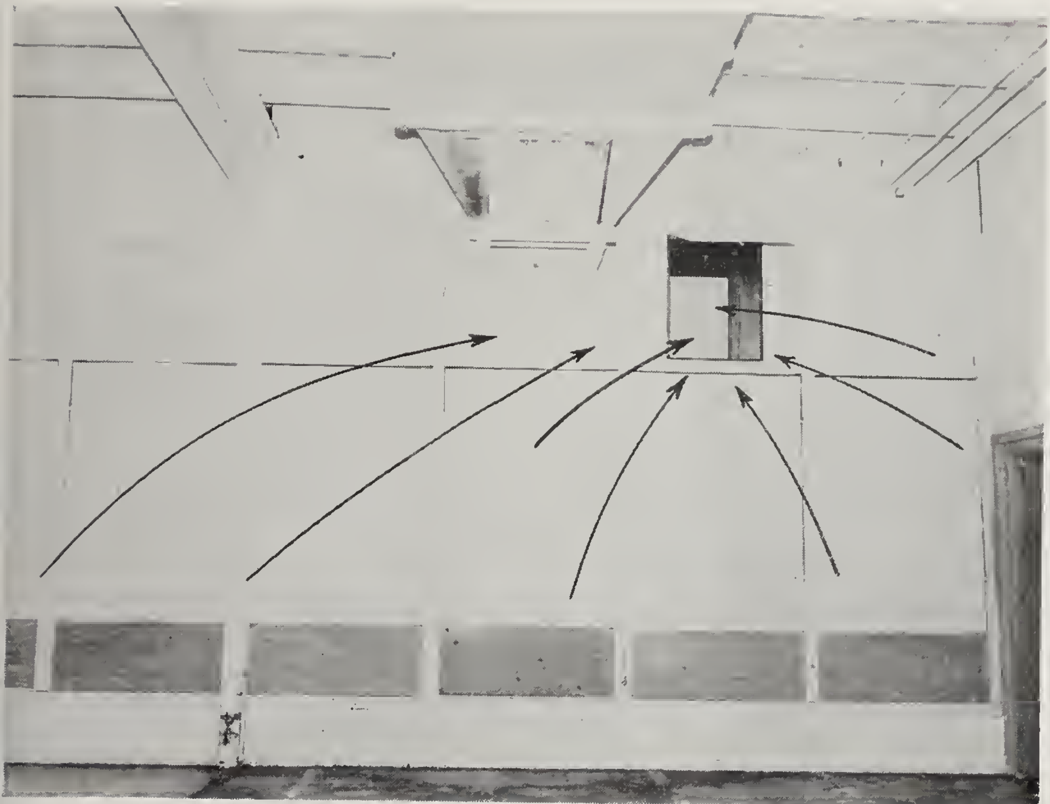


Figure 13.—Section of dry-coil bunker with fan above and bottom louvers open for air circulation through the coil bank.

culation of sulfur dioxide within the room, while avoiding direct contact of the circulating gas with the coils. However, some of the gas reaches the coils by diffusion and even after the room atmosphere is cleared and normal air circulation is resumed, some sulfur dioxide will be present in the air as a result of a gradual release of the fumigant from the fruit and containers.

Unless the coils and supports are thoroughly protected by an acid-resistant coating, it is desirable to provide some means of washing the coils after each fumigation. This can be done by means of a water line placed above the coils with spray nozzles at suitable intervals. At the completion of gassing, the ammonia supply to the coil is shut off and the water valve is opened. Since sulfur dioxide is rather soluble in water the room atmosphere can be cleared rather effectively, with the fans in operation, while the water is flooding down over the coils. At the same time the coils are defrosted and any residual sulfurous acid on the coils is washed away. Figure 15 shows a section of coil bunker with three panels removed to reveal water from overhead nozzles flooding over the coils during the degassing and defrosting period. Usually, somewhat less than 1 hour is required for satisfactory removal of sulfur dioxide from the atmosphere and thorough washing of the coils. Because grapes are usually stored at temperatures slightly below the freezing point of water it is essential that means be provided for draining all water lines in the bunkers at the completion of the washing process.



BN-7118

Figure 14.—Section of dry-coil bunker with bottom louvers closed and door above coils open for bypass during sulfur dioxide fumigation.

BN-7119

Figure 15.—Section of dry-coil bunker with three panels removed to show water from overhead nozzles during degassing and defrosting.

The removal of sulfur dioxide from the storage room atmosphere at the completion of fumigation is accomplished by aeration in those plants that do not have coil washing equipment. In dry-coil bunker rooms the usual arrangement involves a small door at the end of the bunker which opens to the outside. When fumigation is completed this door is opened and outside air is pulled through the bunker and forced into the room by the fans. This builds up some air pressure in the room so that when a room door is partly opened air rushes out of the room. With the usual fan capacity this method will effectively clear a room in 30 to 40 minutes. Of course, some refrigeration is lost by moving outside air into and through the room, but the air does move over the coil before it goes into the room.

Another method sometimes used involves exhausting the air from the room through a flue in the roof. The flue has a built-in fan which, when the flue louver is open, draws air from the room. After the exhaust fan is started an outside door is opened slightly so that a flow of air through the room can be established. With an adequate fan capacity the clearing can be accomplished rapidly, but moving outside air over the fruit during warm weather often causes some condensation of moisture on the fruit and containers. When either method of aeration clearing is used the fumigation and degassing should be done during the night to take advantage of the lower outside temperatures.

Central Brine-Spray Chambers

Many of the older, and a few of the newer cold storages in central California are built with a centrally located brine-spray chamber and blower. The chamber consists of an enclosed bank of direct-expansion ammonia coils which are continually being sprayed with a solution of salt in water. Very effective heat transfer is obtained by moving the air through the fine spray of chilled brine. The cooled air is distributed to the storage rooms by duct systems such as those illustrated in figures 9 and 10.

The central brine-spray chamber requires substantially less ammonia coil, less liquid and suction line, and fewer control valves than the individual room dry-coil bunker system, resulting in a relatively low original cost. However, effective eliminators must be used on the air discharge side of the brine chamber to prevent particles of brine from being carried in the air to the storage rooms. In grape storage rooms it is necessary to neutralize the brine with sodium hydroxide after each sulfur dioxide fumigation. Equipment for determining the hydrogen-ion concentration of the brine should be used and the pH should be maintained in a range of 7.5 to 8 continuously. Usually the brine is also treated with corrosion-preventive chemicals as recommended by the manufacturer. The principal disadvantages of the ducted brine-spray system as applied to grape storages are (1) that it is usually impossible to fumigate a single room because all of the rooms are served by one main air supply duct and one return air duct; (2) that total air volume is usually less from the central blower than from the multiple fans used in the individual room systems; and (3) that uniform air distribution is difficult to attain because of variations in air pressure and velocity in different parts of the supply duct.

It is a commonly held, but erroneous, belief that a brine spray,

when used for cooling, adds humidity to the air. On the contrary, the brine spray picks up moisture from the air to an even greater extent than a frosted coil due to the somewhat lower vapor pressure of brine at comparable temperatures. Wile and Halls (*74*) state that if a brine-spray and dry-coil system operate at the same surface temperature the humidity must be lower with the brine system. Thus, it is essential for maintenance of proper humidity that sufficient coil and brine surface be supplied to maintain a minimum split between refrigerant and air temperature.

As mentioned previously, it is usually impractical to fumigate a single room in a multiple-room plant with a central brine-spray system. Therefore, the whole plant must be fumigated as a unit, using the central blower to circulate the sulfur dioxide. The brine spray is turned off during the fumigation and clearing period, but even with the spray off the brine and coils become acidified if circulation is through the spray chamber. Accordingly, it is desirable to bypass the air around the brine-spray chamber during the gassing and aeration periods. This can be accomplished with a special tunnel around the spray chamber which has suitable louvers for diversion of the air through it when needed. Clearing sulfur dioxide from the storage air is often difficult in the central brine-spray system. If an outside door into the return air duct is provided and an outside storage room door opened at the other extreme of the system, clearing can be accomplished reasonably well.

Unit-Coolers

The unit-cooler is a modification of the brine-spray or dry-coil bunker systems in which the unit contains expansion coils and blowers for moving the air through the coils and discharging it into the room. These may be in the form of relatively small units suspended from the ceiling or large units placed along one wall. These generally have finned coils for extended refrigerating surface and move the air from open fans without ducts. They are usually dry-coil units although some of the larger wall units have built-in brine spray systems. Unit-coolers are not commonly used in grape storage rooms, principally because finned-coils have a limited life when exposed periodically to sulfur dioxide. When such units are used there is a tendency to use too few of them for the maintenance of adequate humidity and air movement. However, there seems to be no reason why unit-coolers should not provide satisfactory conditions for grape storage if the installation is designed to provide adequate refrigerating surface and air volume.

Ice-Refrigerated Storages

Where the storage need is limited to one or two seasonal commodities, with a storage period of only a few months, there has been an increasing tendency to use ice as a source of refrigeration rather than mechanical systems. This is particularly true of storage plants owned by growers who are interested in having precooling facilities available during the harvest season and in storing a limited quantity of fruit for sale during the fall or early winter.

A number of ice-refrigerated storages are in operation in central California. Capacities vary from 4,000 to more than 100,000 lugs of grapes and construction varies from

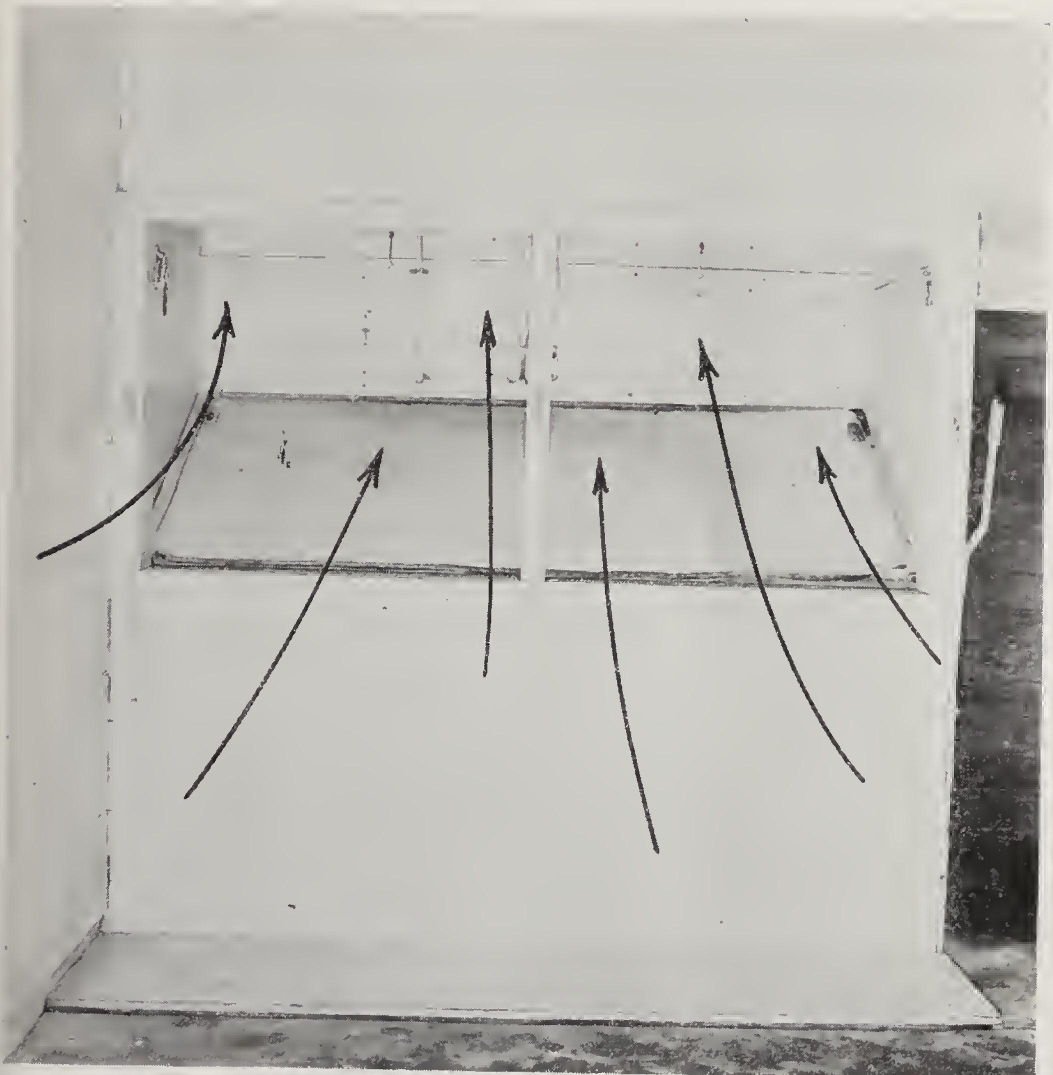
those in which the lugs are hand-trucked and stacked to those with mechanized handling operations and ceiling heights which permit stacking three pallets high. The usual design is similar to that of the individual room dry-coil bunker system, with an ice bunker extending the full length of one wall and fans at the top of the bunker or bunker duct for discharging air into the room. In some cases the bunker is above ground and against the outside of the room. More commonly the bunker is under ground with the loading platform outside the building at its upper surface. This simplifies icing of the bunker, for hatches in the platform are readily accessible and the ice can be handled at truck-bed level. Figure 16 shows the hatches (some open with plugs removed) along the loading platform of an ice-refrigerated storage plant which has underground bunkers.

BN-7120

Figure 16.—Icing hatches for bunkers of ice-refrigerated storage. Bunkers below platform have capacity for about 184 tons of chunk ice.

The first essential of an ice refrigerated plant is adequate bunker capacity. There must be enough ice surface to provide air near 32° F at the discharge points and the volume of the bunkers must be such that the air will not be restricted during passage through the ice. A good rule of thumb seems to be 1 cubic foot of bunker volume for each 10 cubic feet of room space, although several ice-refrigerated rooms are performing satisfactorily with a somewhat lower proportion of bunker capacity to room volume. In cases where the rooms are used primarily for precooling, and for storage only at the end of the harvest season, at least enough ice bunker capacity should be provided so that 1 reicing each day would maintain the refrigeration capacity during the peak load period. Since a much greater air volume is needed during precooling than during storage, some method of reducing air flow should be provided. This can be accomplished most easily by the use of two-speed fan motors.

As stated previously, sulfur dioxide is fairly soluble in water and the surface of melting ice provides a considerable quantity of water. Therefore it is desirable, so that a reasonably constant concentration of gas can be maintained during the fumigation period, for the air to bypass the ice while the sulfur dioxide is being circulated. A satisfactory method of accomplishing this is illustrated in figure 17. The floor grid through which air normally enters the bunker is closed and a hinged panel in the bunker duct is opened. With this arrangement air is pulled directly from the room and discharged again at the top of the bunker duct. Figure 18 shows the same bunker duct section with the grid cover removed and the duct baffle closed for normal air circulation through the ice bunker.



BN-7121

Figure 17.—Section of ice bunker duct with air return grid covered and bypass panel open as used for circulation of SO_2 in the room.

Comparative cost figures between ice-refrigerated and mechanically-refrigerated storages are not available, but it is apparent that the original cost of a mechanically-refrigerated plant would be materially higher than that of an ice-refrigerated plant of the same capacity. On the other hand the cost of operation, on a per-ton of refrigeration basis, would certainly be higher for the ice-refrigerated plant. Even under volume usage, ice probably cannot be purchased on a delivered basis for less than \$5.50 per ton, whereas an efficient mechanical plant should provide refrigeration at \$2 or less per ton. The decision on whether to use ice or mechanical refrigeration must be based on such factors as annual period of operation, available capital, delivered cost of ice, and need for the lower temperatures obtainable with the mechanical plant. The decision must be made on an individual basis, according to prevailing circumstances and need.

BN 7122

Figure 18.—Section of ice bunker duct with air return grid open and bypass panel closed for normal air circulation through the ice bunker.

Factors Affecting Refrigeration Capacity Requirements

The refrigeration requirement of any storage plant must be based on peak refrigeration load. This peak usually occurs when outside temperatures are relatively high and warm fruit is being moved into the plant for precooling and storage. The refrigeration load during the peak of the harvest season will, of course, depend upon the amount of fruit received each day, the temperature of the fruit at the time it is placed under refrigeration, the specific heat of the product and the final temperature attained. Other factors affecting the total heat load include vital heat or heat of respiration, heat leakage through room surfaces and open doors, and heat produced by electric motors, lights, mechanical handling equipment, and workmen.

Field Heat

Field heat, or sensible heat as it is sometimes called, is the heat that must be removed from the product to cool it to a given storage temperature. Any measures that can

A

B

C

Plate 1.—*A*, Stages in the development of gray mold rot. *B*, Stages in the development of Cladosporium rot. *C*, Alternaria rot in Emperor grape.

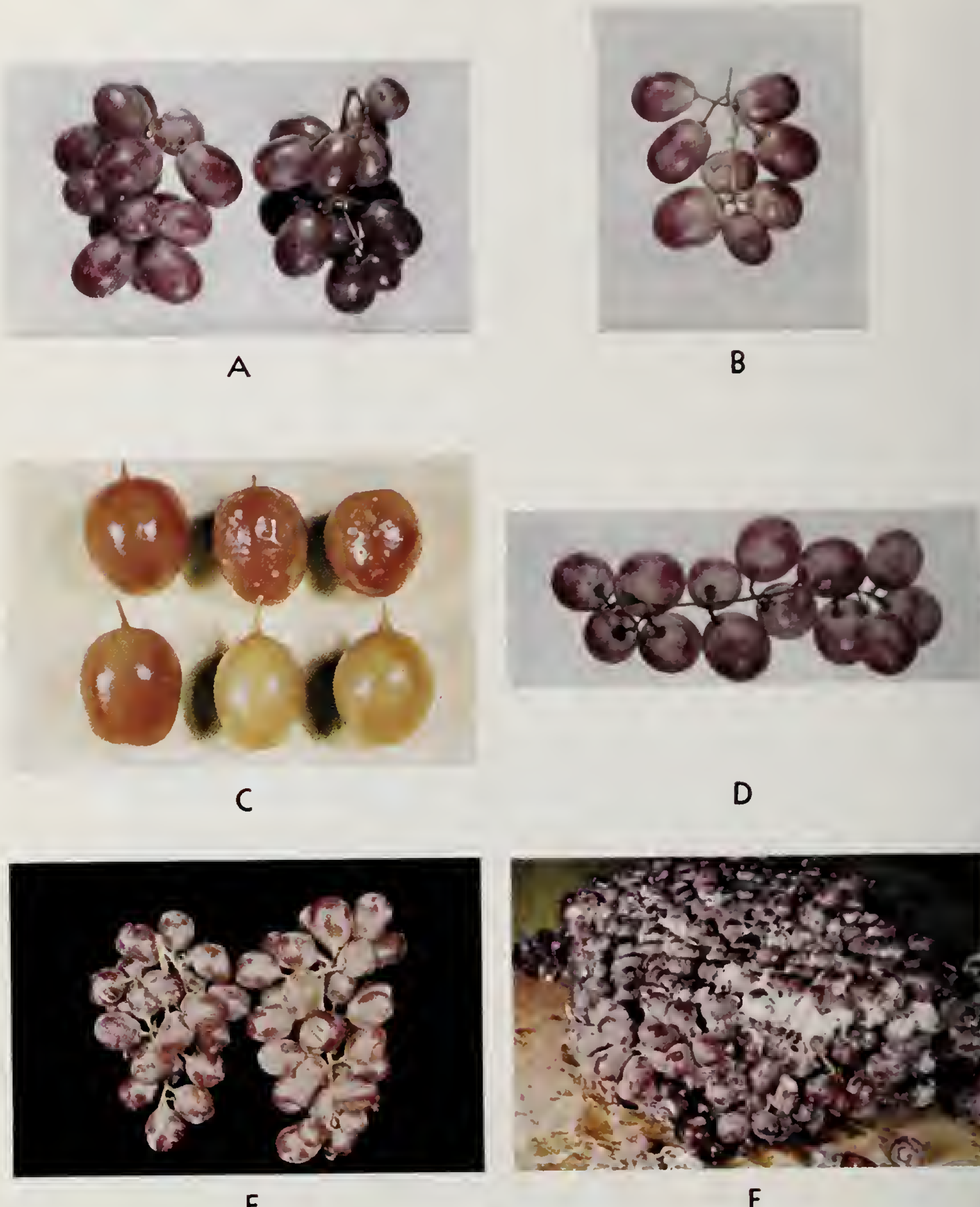


Plate 2.—*A*, Sound (left) and freezing injury (right) to Emperor grapes. *B*, Sulfur dioxide injury to Emperor grapes. C, Sulfur dioxide injury to Tokay grapes. *D*, Ammonia injury to Emperor grapes. *E*, Box bruising of Emperor grapes. *F*, Nest rot stage of gray mold rot.

be taken to avoid high fruit temperatures at delivery, such as harvesting early in the morning or shading the fruit from the sun, will naturally reduce the refrigeration load. The amount of refrigeration required to lower the temperature of a known amount of fruit a given number of degrees can be calculated according to the following formula: R=TR×P×S in which R is the B.t.u.[3] to be removed, TR is the temperature reduction required in degrees F., P equals the pounds of fruit or containers, and S is the specific heat[4] of the commodity.

According to this formula, the refrigeration requirement for reducing the temperature of 1,000 standard display lugs of grapes by 40° F. would be as follows:

Fruit

40 (°TR)×28,000 (P fruit) ×0.82 (S)=918,400 B.t.u.

Boxes

40 (°TR)× 4,000 (P wood)×0.33 (S)= 52,800 B.t.u.

Total—971,200 B.t.u.

Since 144 B.t.u. are required to melt 1 pound of ice, the removal of 971,200 B.t.u. would require an amount of refrigeration equivalent to that provided by the meltage of 6,744 pounds of ice or by 3.37 tons of refrigeration. If a reduction in temperature of more or less than 40° is required to bring the fruit to storage temperature, the heat load, of course, will be correspondingly greater or less than the figure shown.

Vital Heat

Vital heat is that produced by fruits and vegetables as a result of the respiratory process. As mentioned previously, grapes have a relatively low rate of respiration as compared with other fresh fruits and vegetables. However, a certain amount of heat is produced and it must be considered in the calculation of total refrigeration requirements. Vital heat production by several varieties of vinifera grapes (as calculated from the average rate of carbon dioxide evolution at different holding temperatures) has been published (*79*). At temperatures from near 30° to about 100° F., the rate at which this heat is generated increases as the temperature of the fruit increases. In fact, the vital heat produced by grapes almost doubles for each 10° rise in temperature between 32° and 80°.

During precooling, the rate of heat evolution decreases as the temperature is lowered and, consequently, a median fruit temperature should be used to calculate the refrigeration load from evolved heat. For example, in calculating the heat evolved by grapes during cooling from 75° to 35° F., the rate of heat evolution at 53° could be used. For the Thompson Seedless variety this figure is given as 1,690 B.t.u. per ton of fruit per 24 hours. On this basis, 1,000 lugs (14 tons of fruit) of this variety would produce 23,600 B.t.u. and would require about 165 pounds of ice, or its equivalent in mechanical refrigeration, to remove the vital heat alone during a 24-hour precooling period.

After the grapes are down to storage temperature the vital heat production is substantially lower than during the cooling period. Thompson Seedless grapes produce only about 430 B.t.u. per ton per

[3] British thermal unit, the amount of heat required to raise the temperature of 1 pound of water 1° F.

[4] Calculated on the basis of moisture content according to the formula S=0.008 a+0.2 in which S is specific heat, and a is the percentage of water in the product.

24 hours at 32° F., so the vital heat evolved from 1,000 lugs of grapes at this temperature would increase the load by only about 42 pounds of refrigeration per day.

Heat Leakage

A substantial part of the refrigeration load in a cold storage plant is due to heat leakage through exterior walls, the roof, and the floor. The rate of such heat leakage will depend upon the type of insulation used, the thickness of the insulation, the moisture content of the insulation, and the temperature differential existing between the outside temperature and the temperature maintained in the storage room. Shredded redwood bark is commonly used as wall and roof insulating material in California cold storages. The heat conductivity of this insulation has been given (*4*) as 0.26 B.t.u. per hour per 1° F. of temperature difference per square foot of surface of a 1-inch-thick material having a density of 5 pounds per cubic foot. Corkboard has approximately the same insulating value as redwood bark, but such materials as planer shavings and crushed pumice have considerably less insulating value per inch of thickness (*5*). A wall of cinder concrete with a density of 97 pounds per cubic foot permits the passage of approximately 19 times as much heat as redwood bark of similar thickness.

A storage room 25 by 40 feet with a 9-foot ceiling would have 1,170 square feet of wall surface and 1,000 square feet each of ceiling and floor surface. If the walls and ceiling of the room were insulated with 8 inches of redwood bark and the floor with 4 inches of corkboard and if the temperature differential averages were 40° F. on the walls, 50° on the roof and 30° on the floor, approximate heat leakage into the room could be calculated as follows:

Exterior walls *B.t.u.*

$$\frac{1{,}170\ (\text{sq. ft.}) \times 0.26\ (\text{B.t.u./hr.}) \times 24\ (\text{hrs.}) \times 40\ (^\circ\text{TD})}{8\ (\text{in. of RW bark})} = 36{,}504$$

Roof

$$\frac{1{,}000\ (\text{sq. ft.}) \times 0.26\ (\text{B.t.u./hr.}) \times 24\ (\text{hrs.}) \times 50\ (^\circ\text{TD})}{8\ (\text{in. of RW bark})} = 39{,}000$$

Floor

$$\frac{1{,}000\ (\text{sq. ft.}) \times 0.27\ (\text{B.t.u./hr.}) \times 24\ (\text{hrs.}) \times 30\ (^\circ\text{TD})}{4\ (\text{in. of cork})} = 48{,}600$$

Total heat leakage per day------------------------ 124,104

Thus, under the conditions specified, the refrigeration requirement for heat leakage through exterior surfaces would be almost one-half ton per day.

Air Infiltration

Storage room doors are open for substantial periods each day for placement of fruit in the rooms and removal of fruit for shipment. The air entering the room, during the exchange which occurs as a result of temperature differential, may carry large quantities of heat along with it, particularly if outside doors are open. Hukill and Smith (*31*) state that 100,000 B.t.u. per hour can enter a room through a 4- by 7-foot outside door when a temperature differential of 30° F. exists between room air and outside air. It is apparent that any means of reducing this air exchange, such as using light-weight swinging doors

or automatic door-opening and closing devices, will result in a material reduction of total heat load.

Other Heat Sources

Heat is produced by electric motors, electric lights, and the combustion-type motors used on some fruit-handling equipment. All of these sources add to the total heat load in the cold storage plant. The amount of heat evolved from an electric motor can be estimated at 3,000 B.t.u. per hour for each horsepower. Each kilowatt of incandescent light adds about 3,500 B.t.u. per hour. In addition to these mechanical sources of heat, the vital heat produced by workmen accounts for 1,000 B.t.u. per man-hour. A calculation of these factors for a 40-carlot room with six 1-horsepower fan motors operating continuously, six 200-watt lights burning 8 hours each day, and 2 men working in the room for 8 hours each day, will show the heat load in the room from these sources as follows:

	B.t.u.
Electric motors	
6 (motors) × 3,000 (Bt.u./hr.) × 24 (hrs.)	= 432,000
Electric lights	
1.2 (KW) × 3,500 (B.t.u./hr.) × 8 (hrs.)	= 33,600
Workmen	
2 (men) × 1,000 (B.t.u./hr.) × 8 (hrs.)	= 16,000
Total heat load	481,600

Thus the heat produced from incidental sources in this 1 room would require about 1¾ tons of refrigeration per day.

Disorders of Grapes in Storage

During storage grapes are subject to a variety of disorders, some of which result from conditions that exist during storage, some from conditions that already existed when the fruit was placed in storage, and others that result from a combination of postharvest and preharvest factors. Deterioration of fruit in storage can be the result of attack by decay-causing organisms, of natural aging processes, or of chemical, physical, or mechanical injuries. A thorough understanding of each of these factors is necessary to determine the most effective way of controlling them.

Decay

Gray Mold Rot

The fungus *Botrytis cinerea* pers. ex Fr. (gray mold), is widespread in nature and causes decay in many kinds of fruit, vegetables, and ornamentals. Since this organism is capable of growth at low temperatures, it is one of the principal causes of spoilage in grapes held in cold storage. Gray mold is particularly prevalent in varieties such as Emperor, Ribier, or Flame Tokay when they are harvested late in the season after exposure to high moisture conditions.

Symptoms.—Several common names are used to describe the various stages of gray mold rot. The early stage of the disease commonly is called "slip skin" since, after infection, the tissue just beneath the surface of the berry is attacked first, loosening the skin from the underlying flesh. A slight pressure applied to the berry causes the skin to break loose and separate from the firmer underlying tissue, hence the name, "slip skin." There may be a slight browning of the affected areas of the berry, but at this stage, the decay is not readily discernible by appearance alone (plate 1, *A*).

Later, the causal fungus grows through the entire inner flesh of the berry, resulting in a soft, watery mass of decayed tissue enclosed in a still, somewhat intact, but browned skin. Under moist conditions the fungus sporulates on the surface of the berry, producing the typical gray mold stage of the disease. However, when grapes are fumigated in storage, surface growth and spore formation are usually prevented. Fumigation does not prevent development of the fungus within previously infected berries. Diseased berries gradually lose moisture, shrivel, become a darker brown color, and form the mummy stage of decay. In storage the fungus may spread by contact from a diseased berry to adjoining berries, in which case the "nest rot" stage of the disease is formed. When nest rot occurs there is usually a rather well-developed growth of grayish-white mycelium over the surface of the affected berries (plate 2, *F*) (*18, 43*).

Control measures.—There are four primary measures that may be employed to reduce postharvest losses from gray mold rot. Each of these is related to and serves to supplement the others:

1. Grapes that are to be shipped directly to market after harvest should be rapidly cooled to at least 40° F. and those that are to be stored before marketing should be rapidly cooled to 31° to 32° F. Holding grapes at low temperature slows the development of gray mold, but does not in itself provide complete control.

2. Soon after harvest, and at intervals during storage, Vinifera grapes should be fumigated with sulfur dioxide (see section on sulfur dioxide for details). American, or eastern, varieties of grapes are not fumigated because of their susceptibility to injury.

3. Vineyard applications of fungicides to prevent field infections have been effective in reducing decay in storage (*18, 20, 21, 22, 26, 44, 65, 66*). One of the most effective materials tested for this purpose has been captan. This fungicide is usually applied as a dust in a formulation containing 10 percent captan, 50 percent sulfur, and 40 percent inert carrier. Application is made at the rate of 20 pounds per acre with the duster directed toward the clusters. For Emperor grapes grown in California the first application should be made about the middle of July and should be followed by additional dustings at 3- to 4-week intervals with the last one applied not later than 2 weeks before harvest. This is a rather expensive treatment and, though it has been effective in years in which the fruit is exposed to high moisture conditions, it is of no particular benefit in dry years. The grower must consider the economic aspects of the control measure, therefore, before deciding upon its use.

4. Selective marketing to minimize decay losses has been shown to be effective (see separate section on this subject for details). The use of a decay forecast allows the storage operator to market early those lots of grapes in which a high percentage of decay is indicated and to retain in storage only those lots likely to remain sound.

Certain cultural practices have been found to affect the incidence of gray mold rot. The control of insects in the vineyard, for example, indirectly affects decay by reducing wounds in the fruit (*39, 75*). Dense foliage around the fruit and weeds around the base of the vines tend to slow the time required to dry the grapes after exposure to rainfall and thus favor the development of decay (*11, 63*).

Additional references on gray mold rot are: (*19, 40, 41, 53, 55, 56, 60, 67, 68, 69*).

Cladosporium Rot

Cladosporium rot, (*Cladosporium herbarum Pers.*), is an important cause of spoilage in grapes held in cold storage, particularly in the Emperor and Flame Tokay varieties. Like gray mold rot, the causal fungus is capable of growth at and even below storage temperatures.

Symptoms.—Cladosporium causes a black, firm decay that is usually localized on one side of the berry. The decay is not definitely sunken, but the grape is flat or wrinkled on the affected side. The decay is shallow and usually does not extend to the seeds. The affected tissue is firmly attached to the skin and can be easily removed with it. In storage, signs of the fungus are usually not present on the surface of the affected berries (Plate 1, B), but when the fruit is removed from storage and placed at room temperature, a sparse surface growth of gray-green fungus may be produced (*18*). Cladosporium rot is easily distinguished from gray mold rot by its black color and the fact that it usually remains localized rather than affecting the entire berry.

Control measures.—Fumigation of vinifera grapes with sulfur dioxide reduces postharvest infections of grapes by Cladosporium and other fungi and reduces spread of decay from affected to sound berries in storage and transit (see section on sulfur dioxide). Applications of fungicides in the vineyard have reduced the development of Cladosporium rot in stored grapes but the disease is usually not serious enough to warrant the expense of applying fungicides in the field (*26*). Additional references on Cladosporium rot are: (*7*, *13*, *17*).

Alternaria Rot

During the storage of Emperor and some other varieties of grapes, decay caused by species of *Alternaria* and *Stemphylium* may develop. Infections by these organisms seem to occur quite early in the harvest season, even in the absence of rainfall (*26*, *27*). The causal fungi often gain entrance into the berry through the capstem, causing a localized tan to dark brown decayed area in the berry (plate 1, *C*). Since the fibrous conductive tissue ("brush") that leads into the berry from the capstem is attacked, affected berries are easily shaken from the cluster. Species of *Alternaria* and *Stemphylium* may occasionally be isolated from other parts of the berry where they cause symptoms quite similar to those caused by *Cladosporium*, but which are not as dark in color.

Other Types of Decay

Although table grapes are subject to many types of decay in the field, only the above-mentioned organisms commonly cause decay at low storage temperatures under California conditions. Decay caused in the field by organisms that are active only at high temperatures is usually culled out at harvest or during packing and, consequently, is not a serious disorder in storage. For information regarding these disorders refer to U.S. Department of Agriculture Miscellaneous Publication No. 340, Market Diseases of Fruits and Vegetables: Grapes and Other Small Fruits (*60*).

Physiologic Aging

Unlike certain other fruits, grapes do not ripen after harvest or improve in flavor or texture during storage. Since there is no starch reserve in the grape, there is no increase in sugar content after harvest. Grapes, therefore, are at prime quality at harvest, and subsequently suffer a gradual decline in quality.

As grapes approach the end of their storage life the berries become somewhat dull in color, losing the brightness they had at harvest. Red varieties assume a gray-purple color and green varieties turn a gray-green to brown color. The texture becomes soft and flaccid and the flavor resembles that found in raisins.

Though picked from the vine, the grape is still a living organism in which a considerable amount of sugar (carbohydrate) is stored. The vital processes (respiration) that go on in the fruit after harvest gradually use up the stored carbohydrates, taking up oxygen and releasing carbon dioxide, water, and a certain amount of heat in the process (see section on vital heat). The evolution of heat, which is a measure of respiratory activity, is lower in vinifera grapes at 32° F. than in any other fruit except the Winesap apple (*79*). Factors that affect the rate of respiration and consequently the aging of grapes in storage are temperature, fruit maturity at harvest, variety, and sulfur dioxide fumigation.

Temperature.—Temperature is the most important factor affecting the rate of respiration. Within certain limits, the respiration rate decreases with a lowering of the temperature. De Villiers (*14*) demonstrated that the respiration rate in Red Muscat grapes was about 2½ times as great at 50° as at 32° F., 7 times as great at 68° as at 32° F., and 18 times as great at 86° as at 32° F. The importance of rapid cooling in relation to the storage life of the fruit is apparent from these results.

Maturity.—Immature grapes have a higher rate of respiration than mature ones. De Villiers found that in Mataro grapes the respiration rate was about 1½ times as great in green as in firm ripe fruit. Differences in respiration rates due to maturity were greatest immediately after harvest and became less pronounced toward the end of the holding period. Grapes to be stored for long periods, therefore, should be of prime maturity, but not overripe. Since over-ripe fruit is more susceptible to infection by the gray mold fungus than less mature fruit, this factor should also be considered when selecting fruit for long-term storage. Fruit having green, immature stems appears to age more rapidly in storage than fruit with strong, amber-colored, mature stems.

Variety.—The rate of respiration differs considerably among different varieties of grapes. In general, poor keeping varieties have a higher rate of respiration than varieties that keep well in storage (*14*). Thompson Seedless grapes, for example, which have a maximum storage life of about 100 days, respire more rapidly and evolve more heat at 32° F. than Emperor or Almeria, both of which can be successfully stored for periods as long as 6 or 7 months. The normal storage life of several grape varieties is shown below. Certain lots of each of these varieties may keep for longer or shorter periods, depending upon the quality at harvest.

Variety:	*Months in storage*
Muscat (Alexandria)	1 to 1½
Flame Tokay	1½ to 2½
Thompson Seedless (Sultanina)	2 to 3
Red Malaga (Castiza)	2 to 3
Malaga (White Malaga)	2 to 3
Almeria (Ohanez)	3 to 5
Ribier (Alphonse Lavallee)	3 to 5
Emperor	4 to 6

Sulfur dioxide fumigation.—Several workers have found evidence that fumigation with sulfur dioxide slows the rate of respiration and thereby contributes to a lengthening of the storage life of the fruit by physiologic means as well as through decay control (see section on fumigation with sulfur dioxide).

Chemical Injury

The principal chemicals to which grapes may be exposed in storage are sulfur dioxide and ammonia gas.

For information concerning injury with sulfur dioxide, see section on fumigation with this chemical and plate 2, *B*, *C*.

In plants using a direct expansion refrigeration system, grapes are sometimes exposed to ammonia gas that has escaped into the atmosphere of the storage room. Red-colored grapes turn blue and green-colored fruit assumes a slightly bluish cast in the presence of ammonia (plate 2, *D*). The change in color is caused by the reaction of ammonia with the sap in the cells near the surface of the fruit. When exposed to the gas the sap becomes less acid and the acid-sensitive pigments (anthocyanins) in these cells change color.

Most of the gas enters the berries around the capstem attachment, and the adjacent tissues develop the greatest discoloration. Similar discolored areas may form around wounds in the skin. When exposed to ammonia the capstems turn dark blue or black and portions of the stems become blue (*16*).

When an ammonia leak is detected, the gas should be cleared from the room as soon as possible because slight discolorations from the gas disappear when the fruit is removed from the ammonia atmosphere. The fruit will not recover from severe injury resulting from long exposures to the gas. The best way to remove ammonia from the room is with water. In rooms equipped with a spray system for clearing the room of sulfur dioxide this can easily be done.

Another way of minimizing damage from ammonia is to neutralize it with sulfur dioxide. Sulfur dioxide reacts with ammonia to form ammonium bisulfite, a whitish crystalline substance. Approximately 4 pounds of sulfur dioxide are required to neutralize 1 pound of ammonia. No more than a 1 percent concentration of sulfur dioxide should be used, as higher concentrations might cause injury to the fruit. If commodities other than grapes are stored in the room, sulfur dioxide cannot be applied.

Freezing Injury

Vinifera grape varieties when injured by freezing have a dull appearance and are soft and flabby. After severe freezings they turn brown and become wet and sticky (plate 2, A). The berries of most varieties will not freeze at temperatures as low as 28° F. because of the high sugar content. However, the stems and capstems are often injured by temperatures that apparently have no effect on the berries. The frozen stems are at first limp and pliable, with a water-soaked or dark-green appearance; but they soon dry, become dark colored, and are more susceptible to mold invasion than sound stems. However, if grapes are frozen after having been fumigated with sulfur dioxide in storage, the stems may not turn dark, but retain their former green or straw-yellow color. When berries, injured by freezing, are pulled off the capstem, the brush (the small bundle of fibres that extends from the capstem into the berry) is usually found to be shorter than normal and somewhat browned (*60, 79*).

Desiccation

Desiccation in storage is evidenced by dry stems, shriveling of the berries near the capstems, and by loss of weight. There are several factors that affect desiccation in storage grapes:

Temperature.—High temperatures in the field at harvest and ex-

posure to high temperatures after harvest result in a rapid drying of the stems and shriveling of the berries. Stems dry and turn brown almost four times as fast at 100° as at 70° F. and the berries lose weight six times as fast at 100° as at 70° F. (*42*). The importance of careful handling to prevent exposure to high temperature is obvious. There is evidence that picking grapes in the cool part of the day lessens drying of the stems (*23*, *8*, *9*). Fruit should not stand in the field or in the sun for long periods and should be precooled to storage temperatures as rapidly as possible. The longer it takes to bring the temperature of the fruit down to the air temperature of the precooling or storage room, the greater the loss of moisture from the fruit (see section on precooling).

Humidity studies in South Africa have shown that picking fruit during periods of high humidity lessens drying of the stems (*23*). It should be pointed out, however, that such conditions also favor the development of gray mold rot. The maintenance of relative humidity at approximately 90 percent in storage will aid in preventing excessive drying of the stems (see section on relative humidity). The relative humidity of the air surrounding the fruit within the package is affected by air movement around the package in the storage room. Once the fruit is cooled, it is desirable to provide only enough air movement to maintain the 31° F. temperature of the fruit. In rooms where favorable levels of relative humidity or air velocity cannot be maintained, curtains and package liners of various types may be helpful in preventing desiccation. However, these are a disadvantage during precooling.

Maturity.—In California storage varieties, such as Emperor, there is less desiccation in mature than in immature fruit. As the fruit matures the skin becomes more lignified and more resistant to water loss (*14*). Many growers do not harvest the Emperor until the stems have developed a woody texture and have begun to turn yellow or amber. When the vines are overcropped the stems remain green and weak, the fruit fails to mature properly or there is a delay in reaching maturity. Cultural practices that favor early maturity of the grapes, therefore, provide fruit that is less susceptible to desiccation and less likely to be exposed to conditions favoring gray mold rot.

Mechanical Injury

Shatter

One of the most common forms of mechanical injury in California table grapes is shatter (the separation of the berries from the cluster). Varieties differ greatly in their susceptibility to this disorder. The Flame Tokay and Thompson Seedless (Sultanina) varieties are especially subject to shatter while the Emperor and Ribier are relatively resistant. In most vinifera varieties shatter results from a pulling of the "brush" from the flesh of the berry while in certain labrusca types an abscission layer develops at the junction of the capstem (pedicel) and the berry (*47*). This latter type of shatter is also characteristic of certain vinifera varieties grown in South Africa (*8*, *9*).

Rough handling during picking, packing, and transit is responsible for a large part of the shatter that occurs in storage grapes. W. T. Pentzer of the U.S. Department of Agriculture (unpublished data) found that shatter caused by transit impacts could be materially reduced by eliminating all slack from the load in the refrigerator car. This was done by compressing the load with a mechanical "car-squeeze" and bracing the center space so that

load tightness is retained during transit. Cultural practices such as thinning help to strengthen the stems and reduce shatter. There is also evidence that hot, dry weather and a deficiency of soil moisture during the period of ripening contribute to shatter (*8, 9*). Girdling Thompson Seedless vines to increase the size of the berries also strengthens the attachment of the berries to the stems, thereby reducing shatter (*33*). Pentzer (*47*) found that naphthalene acetic acid (NAA) did not affect the adherence of the berries in vinifera grapes, although this material was found to reduce drop in other fruits. He attributed the ineffectiveness of NAA applications to vinifera grapes to the lack of a definite abscission layer. Grapes that firmly adhere to the stems at harvest sometimes develop shatter after prolonged storage. If grapes are allowed to become over-mature before harvesting, more shatter occurs than when the fruit is harvested at prime maturity (*14*).

Postharvest conditions that favor desiccation also favor shatter. Shatter is reduced by rapidly cooling the fruit as soon after harvest as possible.

Bruising

Bruising commonly occurs in berries that are in contact with the sides or bottom of the packed container (plate 2, *E*). Affected berries are somewhat flattened, show a brown discoloration, and are situated on one side of the bunch. When grapes are fumigated in storage or transit, the bruised areas may become bleached as sulfur dioxide penetrates the berry readily at points where the skin is weakened. The small, dried undeveloped "shot berries" that drop off the cluster and collect in the bottom of the box sometimes puncture or bruise the skin. Severe bruising may predispose the fruit to infection by decay organisms.

Protective liners to prevent the fruit from touching the wooden sides of the box and adequate padding in the bottom of the box help to reduce bruising.

Berry Cracking

As the temperature of fruits is lowered, the turgidity generally increases. Varieties in which the berries have thin skins, such as Thompson Seedless, will sometimes crack during precooling or in the early stages of cold storage. Cracks in the skin can frequently be found in the Flame Tokay at harvest and may be infected with the Cladosporium fungus. These cracks are crescent-shaped, usually occur at the blossom end of the berry, and are rarely over one-fourth inch long and one-eighth inch deep. The disorder apparently occurs more extensively in grapes that are very turgid at harvest as a result of exposure to wet weather or other high moisture conditions. No effective control measures have been developed for cracking. Fortunately it affects a relatively small proportion of the crop.

Fumigation With Sulfur Dioxide

The effectiveness of sulfur dioxide in retarding the activity of spoilage organisms in fresh grapes was demonstrated in 1925 by Winkler and Jacob (*77*). Shortly thereafter, methods of applying the gas to commercial shipments of grapes were developed (*32*) and the various factors related to decay control and fumigation injury were determined (*6, 30, 32, 48, 49, 77*).

Sulfur dioxide is used primarily to control grey mold rot in storage. Grey mold (*Botrytis cinerea*) is

one of the few organisms causing grape decay that is capable of growth at the low temperatures at which grapes are stored. If the berries are infected with this organism before storage, fumigation with sulfur dioxide is ineffective in killing such infections and the decay continues to develop. However, the gas kills fungus spores present on the surface of the fruit and consequently prevents post-harvest infections. When properly applied it also prevents the spread of decay by contact from previously infected berries to sound ones, thus eliminating "nest-rot."

Decay caused by the other low temperature organisms, *Cladosporium herbarum* and species of *Alternaria*, is also reduced by sulfur dioxide fumigation. As in grey mold, fumigation kills spores on the surface, but does not control infections that have occurred before storage (*27*).

In addition to reducing decay, sulfur dioxide is effective in setting the light green or straw yellow color of the stems. Without fumigation grape stems turn a dark brown or black color in storage. Fumigation also tends to prevent the berries from becoming separated from the cluster ("shattering") (*34*, *35*, *58*). Wounds that would otherwise act as entrance ports for decay organisms are cauterized by the fumigation.

Grapes treated with sulfur dioxide have a slower rate of respiration than untreated ones (*52*, *77*) and this lowered rate of respiration tends to lengthen the storage life of the fruit. Pentzer *et al* (*52*) found that when Emperor grape tissue contained 87 p.p.m. sulfur dioxide, respiration was reduced to 8 percent of normal at 32° F. However, at this concentration the gas caused serious injury to the fruit. At a concentration of 22 p.p.m. no injury occurred and the respiration rate was reduced to 82 percent of that in an untreated check lot. Although the effect of sulfur dioxide on the respiration rate is slight at the concentrations employed commercially, there is a small reduction in the loss of stored carbohydrates from the fruit. The sensitivity of the relationship between the respiration rate and the concentration of sulfur dioxide in the tissues is demonstrated by the fact that the respiration rate increases during the intervals between fumigations in storage (*37*).

Methods of Applying Sulfur Dioxide

Sulfur dioxide may be applied either by releasing the compressed gas from steel cylinders, or by adding potassium or sodium bisulfite to the package. At one time the gas was generated by burning sulfur in the fumigation chamber, but this method is no longer in common usage.

Fumigation With the Liquified Gas

Fumigation may be accomplished in special fumigation rooms, in precooling rooms, in refrigerated storage rooms, or in railway refrigerator cars. Initially a 1 percent concentration of gas is applied to the fruit for 20 minutes. This is often done in a special gassing room at prevailing outside air temperatures. During cold storage the fruit is fumigated at weekly or 10-day intervals with ¼ percent concentrations of sulfur dioxide for 20 minutes (*29*, *61*).

The concentration of gas can be calculated on the basis of free air space in the chamber used for the fumigation (*2*). First, determine the volume of the chamber in cubic feet; next subtract 0.5 cubic foot for each lug of grapes to be fumigated. The fruit in each lug occupies ap-

proximately 0.5 cubic foot of space, when air voids between the berries are taken into account. Since 1 pound of sulfur dioxide is equivalent to 5.5 cubic feet of gas at 32° F., the free space (cubic feet) in the chamber multiplied by the percent concentration desired, divided by 5.5 will give the pounds of gas needed. For example, the amount of sulfur dioxide required to make a 0.25 percent concentration of the gas in a 3,200 cubic foot storage room containing 500 lugs of grapes is calculated as follows:

$$\frac{[3{,}200-(500\times 0.5)]\times 0.0025}{5.5} = 1.34 \text{ lbs.}$$

Cylinders containing the correct weight of gas for specific storage rooms or other fumigation chambers are provided by various service companies to the storage operator. The cylinder is connected to a pipe leading into the fumigation chamber, the valve is opened and the cylinder is heated in a water bath to drive all the gas into the chamber. The sulfur dioxide is rapidly mixed with the atmosphere inside the chamber by fans or blowers to insure uniform distribution of the fumigant.

After a 20-minute exposure of the fruit to the fumigant, the sulfur dioxide is removed either by opening room doors, by ceiling exhaust fans or by a water spray system (see section on refrigeration systems). Sulfur dioxide is usually cleared from fumigated refrigerator cars by circulating the air through the ice bunkers. The gas is dissolved in the film of water on the melting ice surfaces.

For fumigating grapes in a refrigerator car a fan with canvas baffles should be used in the brace to distribute the sulfur dioxide uniformly in the load. Without a brace fan, injurious concentrations of gas accumulate in the space above the load and in the open brace, and relatively little fumigant reaches the fruit within the load, providing poor control of decay (*72*).

A method sometimes used to estimate the amount of gas needed for a 0.25 percent concentration is to use ¾ to 1 pound of gas for each 1,000 lugs of grapes. Until the room is half filled with grapes an additional ¼ pound of sulfur dioxide is used for each carload unit of empty space. Thereafter, no gas is added for the unoccupied space (*2*).

Under experimental conditions it has been found that continuous exposures to very low concentrations of sulfur dioxide (30 p.p.m.) were effective in controlling decay and resulted in less injury to certain grape varieties than did short exposures of higher concentrations of gas (*35*, *37*, *58*). To utilize this method of fumigation a device to automatically control the concentration of sulfur dioxide in the storage room was developed in South Africa. Although this method of fumigating grapes may be adaptable to certain types of small storages, the maintenance of a constant concentration of sulfur dioxide in large storage rooms would be difficult as it would preclude normal handling operations to remove fruit at intervals for marketing. In rooms using ice as a refrigerant, low concentrations of sulfur dioxide could not be maintained as the gas would be absorbed by the ice. The same difficulty would be encountered in rooms refrigerated by a brine-spray system.

Fumigation With Bisulfite

Sodium or potassium bisulfite is utilized as a source of sulfur dioxide under conditions that preclude fumigation of grapes in the storage

room or refrigerator car. Such conditions exist in fruit that is exported in the sawdust pack and which cannot be "room fumigated" during transit aboard ship. Prior to shipment, grapes destined for export are usually fumigated in the usual way at intervals during storage and the sawdust and bisulfite are not added until the grapes are ready to be shipped. The sawdust acts as a dispersing agent for the bisulfite as well as a cushion for the fruit against mechanical injury.

Sodium bisulfite can also be used in the standard display lug by distributing the powder evenly in the excelsior pad placed in the bottom of the box. The pad is slit to add the bisulfite and the paper cover is then replaced so that the fruit is not in direct contact with the powder. Not over 5 grams of bisulfite should be used in either the standard 28-pound display lug or in the sawdust pack as larger amounts may cause injury to the fruit (*6, 45, 48, 49*).

Sulfur dioxide is produced as a result of the reaction of bisulfite with moisture in the atmosphere. If there is not too much moisture in the package, the release of gas is quite slow and the fruit, therefore, is exposed to low concentrations of sulfur dioxide over a long period of time. Care must be taken, however, never to use bisulfite under abnormally high moisture conditions as this would result in such a rapid release of gas that chemical injury to the fruit would occur. Such high moisture conditions would exist, for example, if wet sawdust were used or if wet fruit were packed.

The rate at which bisulfite releases sulfur dioxide gas can be regulated to a degree by mixing it with various hygroscopic materials, such as dehydrated alum or silica gel (*38, 57, 59, 71, 73*). Such materials reduce the amount of moisture available for reaction with the bisulfite and consequently slow the release of gas. However, these methods have only been used under experimental conditions and have not gained wide commercial application in the United States.

Symptoms of Sulfur Dioxide Injury

One of the most common types of injury that may occur in grapes fumigated with sulfur dioxide gas is a bleaching or discoloration of the fruit. This is most pronounced at breaks in the skin or at the attachment of the capstem to the berry. Although the gas can enter the berry through the vascular tissue of the capstem, it penetrates more readily through tears that occur in the skin near the capstem attachment during handling. As a result, the tissue underlying such wounds tends to dry out and collapse, forming a pit or depression that is a well-known symptom of sulfur dioxide injury. This type of injury is particularly prevalent in the Emperor variety when stored for long periods (plate 2, *B*).

In certain varieties, such as Flame Tokay, injury may occur as small, bleached, and slightly sunken pits scattered over the entire surface of the berry (plate 2, *C*). These detract from the normal bright color of the fruit and can make the fruit unmarketable.

When sulfur dioxide injury occurs in red varieties, the color of affected areas of the berries may change to pink or white; with blue or black varieties, the color becomes a lighter blue or pink; and with white varieties, affected areas sometimes assume a greyish cast. Injury is more apparent after the grapes have been exposed to warm temperatures for several hours than

it is immediately after the fruit is removed from cold storage. Injured berries may turn brown at warm temperatures due to oxidation reactions in the affected tissues.

Immediately after fumigation, grapes may have a slightly sulfurous taste and badly injured fruit may have a distinctly disagreeable, astringent flavor. However, it has been found that 50 percent of the sulfur dioxide residue in the fruit disappears within 2 days after treatment and the fruit is almost entirely free of sulfur dioxide within 5 days after treatment (*48*). Consequently, fruit treated when shipped from California is almost entirely free from sulfur dioxide by the time it reaches eastern markets.

Factors Affecting Sulfur Dioxide Injury

The amount of sulfur dioxide injury that develops in fumigated grapes is directly related to the amount of the fumigant absorbed by the fruit. Absorption of sulfur dioxide is dependent upon the particular variety, the maturity of the fruit, the fruit temperature, the presence of wounds and the concentration, frequency, and length of exposure to the gas.

Variety

Certain varieties of table grapes such as Malaga, Thompson Seedless (Sultanina), and Castiza (Red Malaga) absorb sulfur dioxide more rapidly than Ribier (Alphonse Lavallee) and Alicante Buschet. The rate of SO_2 absorption by the Emperor variety is slightly greater than that of Ribier, but considerably lower than that of Thompson Seedless (*48, 51*). Flame Tokay is quite susceptible to injury as evidenced by the pitting that frequently is found over the surface of this variety after fumigation (*54*). Many of the varieties of grapes grown in South Africa are particularly subject to injury from sulfur dioxide. Consequently, when the fumigant is employed, it is administered in much lower concentrations than are used commonly under commercial conditions in the United States (*18, 58*).

Maturity

Immature fruit absorbs gas more rapidly than mature fruit (*48*). Winkler and Jacob (*32, 77*) found that ripe Muscat grapes (27° Balling) absorbed about one-half as much sulfur dioxide as green ones (18° Balling) and about one-sixth as much as very green ones (13° Balling). Since very mature grapes are more subject to infection by decay organisms and absorb sulfur dioxide less readily than immature grapes, it may sometimes be desirable to fumigate them with slightly higher concentrations of gas than are ordinarily used.

Fruit Temperature

Warm grapes absorb more sulfur dioxide than cold grapes (*32, 48, 77*). Pentzer and Asbury (*48*) found that Thompson Seedless grapes absorbed more than twice as much gas at 72° than at 39° F. Malaga grapes absorbed almost three times as much gas at 75° than at 48° F. Temperature is a particularly important factor in sulfur dioxide injury when varieties that absorb sulfur dioxide rapidly are being fumigated (*58*).

Wounding

The intact skin of most varieties of vinifera table grapes grown commercially in California possesses a high degree of resistance to penetration by sulfur dioxide gas. However, the gas is able to penetrate the berry through the vascular tissue of the capstem and readily

penetrates through any type of perforation of the skin caused by physical wounding, the activity of decay-causing organisms, or other weakening factors. These characteristics are desirable to a certain degree since the fumigant tends to concentrate in the tissue at points that are most susceptible to invasion by spoilage organisms. The fact that grapes are to be fumigated, however, is no excuse for rough or careless handling, as the bleached, pitted areas that form at points of wounding lower the quality of the fruit (*32, 77*).

Concentration and Length of Exposure to Fumigant

The higher the concentration and the longer the exposure, the more sulfur dioxide grapes absorb. Of all the factors considered, these are the most important in relation to fumigation injury. The use of circulating fans or blowers is essential to distribute the gas uniformly in the fumigation chamber and to prevent injurious concentrations from building up near the gas inlet. It is also important that an efficient method of exhausting the room of fumigant is used to prevent over-exposure to the gas. When refrigerator cars are fumigated, allowance must be made for the ice in the bunkers since sulfur dioxide is rapidly absorbed by the melting ice.

To determine the concentration and length of exposure that will control spoilage organisms without injury to the fruit, all the above factors as well as those related to infection by decay organisms must be considered. The concentrations and exposures cited under "Methods of Applying Sulfur Dioxide" meet the needs for fumigation under average conditions. Commercial operators sometimes vary the concentration and exposure to meet the needs of specific situations. Obviously, since a given storage room may contain grapes of several varieties, maturities, and with different decay potentials, one treatment cannot fit the optimum requirements for each factor. To cite an extreme example, the fumigation requirements of an immature, warm, injury-susceptible variety, not exposed to conditions favoring infection would be quite different from those of a mature, cooled, injury-resistant variety that had been exposed to rainfall.

Workers in South Africa have found that certain of their varieties can absorb about 20 p.p.m. SO_2 without injury. This concentration of sulfur dioxide in the tissue was obtained if the grapes were fumigated with 0.25 to 0.3 percent of the gas for 20 minutes (*58*). Consequently, the 1 percent concentration of SO_2 commonly used for the initial fumigation of grapes in the United States would not at all be suitable for fumigation of these South African varieties.

Frequency of Fumigation During Storage

Another factor affecting the amount of sulfur dioxide absorbed by grapes is the frequency at which fumigations are made during the storage period. The common commercial practice is to fumigate at 7- or 10-day intervals with a 0.25 percent concentration of gas for 20 minutes. Under laboratory conditions grapes were fumigated at intervals of 7, 14, or 21 days to determine the effect of frequency of SO_2 fumigation on injury and decay development. No consistent relation between frequency of fumigation and injury could be demonstrated in these studies. There was some evidence that mechanical injuries, which allowed the gas to penetrate the berries more readily.

and the high initial concentration of gas (1 percent) were more important as causes of injury than was frequency of fumigation during storage. When grapes were stored for long periods (5 months), more decay developed in those that received the less frequent fumigations than in those that were fumigated more often. The frequencies of fumigation used in this study had no significant effect on decay in grapes stored for short periods (3 months) (*29*).

Precautions To Follow When Using Sulfur Dioxide

Human Toxicity

The pungent odor of sulfur dioxide is easily recognized and can be detected in concentrations as low as 30 to 40 parts per million (p.p.m.). At 400 p.p.m. the gas becomes extremely irritating and can cause injury to the mucous membranes of the eyes, nose, and mouth. At 2,500 p.p.m. (0.25 percent, the concentration commonly used to fumigate grapes in storage), the gas can cause respiratory spasms and death if the victim cannot escape from the fumes (*3*).

If exposed to irritating concentrations of the gas, affected areas should be flushed with large quantities of water. A few drops of dilute ephedrinal sulfate will give relief when applied to the nose. Goggles and a gas mask effective against acid type gases should be worn in the presence of even weak concentrations of the gas.

Injury to Other Commodities

Grapes are almost unique in their ability to withstand sulfur dioxide fumigation. Concentrations of the gas commonly applied to grapes cause severe injury to almost all other fresh fruits and vegetables. For this reason grapes must not be stored in the same room with other produce and during fumigation the gas must not be allowed to move through leaks in walls, or through hallways or ductwork into adjoining rooms where other commodities are stored. If grapes are shipped in mixed loads with other fruit in a refrigerator car, the car must not be fumigated. Severe injury to peaches, nectarines, plums, and other commodities has been observed when these fruits have been shipped with grapes in fumigated cars.

Corrosive Effect on Equipment

Sulfur dioxide forms sulfurous acid when dissolved in water. Metal surfaces upon which moisture collects in cold storage rooms therefore become covered with sulfurous acid during and after fumigation. The acid is extremely corrosive to both iron and zinc, causing the deterioration of coils, brine-spray chambers, and other equipment made of these metals. Some protection is afforded by treating exposed metals with acid resistant paints. A minimum of electrical wiring should be used inside grape storage rooms and switches and other control equipment should be located outside the room if possible.

Other Precautions

Certain precautions already noted under "Factors affecting sulfur dioxide injury" should be stressed. When bisulfite is being used as a fumigant no more than 5 grams per lug or chest should be applied. It should be evenly dispersed in the package and not in contact with the fruit and it should not be used with wet grapes or wet sawdust. Grapes treated with bisulfite should not be refumigated with sulfur dioxide in storage because bleaching may result from the combined treatment (*45*).

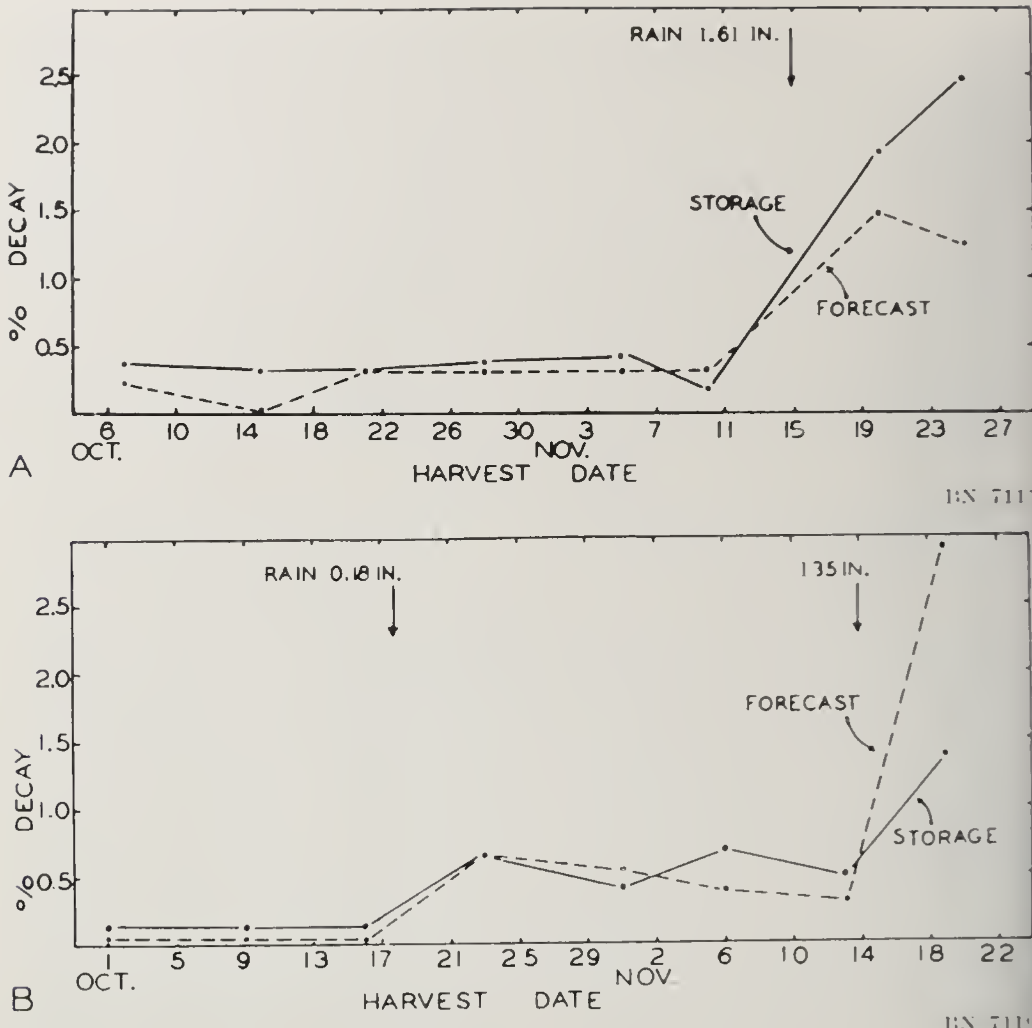


Figure 19.—Interrelation of decay forecast and decay actually developing in stored Emperor grapes. *A*, Fresno vineyard, 1952. *B*, Fresno vineyard, 1953.

Selective Marketing of Storage Lots

Since decay and other disorders vary considerably from one lot of stored grapes to another, it is desirable to arrange and identify the lots in storage in a way that will enable the shipper to market poor keeping lots early and retain only sound, high-quality fruit for late marketing. To determine the keeping quality of different lots of grapes, the shipper may rely on his knowledge of the storage history of fruit harvested in past years from various vineyards, on the general appearance of the fruit at harvest, on the weather to which the fruit had been exposed before harvest, on periodic inspections made during the storage period, or on a laboratory forecast of the potential storage decay present in specific lots of fruit at harvest. A rating of lots based on all but the last two of these factors requires a considerable amount of experience and reliable storage records over a period of years. Such may not be available in a new storage plant, in one in which the personnel are new, or in one storing fruit that may come from a different source each year. Neither can fac-

ors related to the effect of expo-ure to weather before harvest al-ays be accurately evaluated. nspection and forecasting, there-ore, offer a more precise way of neasuring and estimating storage isorders.

Inspection in Storage

Stowage of grapes in storage hould allow ready access to each ot and inspections of randomly se-ected boxes from each lot should e made at regular intervals. Lots n which decay begins to appear re marketed immediately but if oo much decay is present, the fruit ay have to be trimmed and re-acked. If a lot is not inspected requently enough, decay may de-lop to the point where the whole t becomes unsalvageable. The requency at which grapes are in-ected in storage varies with the me of year and the opinion of the orage operator about the keeping uality of the particular lot. If a t was suspected of being particu-rly subject to decay, it would obably be inspected at weekly in-rvals or before each fumigation. ruit thought to be sound would be spected less frequently. At the ginning of the storage period in-ections are usually less frequent an they are toward the end of orage.

recasting Decay in Storage Grapes

Most of the decay that develops ring storage in the Emperor and her late-harvested storage vari-ies is caused by the gray mold ngus, *Botrytis cinerea*. A ethod of measuring the potential nount of decay in storage caused this organism has been devel-ed and found to be exceptionally curate under laboratory condi-ons. The method has also been adapted to several commercial stor-age operations and has been used as a guide to marketing individual lots of storage grapes (*28*).

The forecast is based on the premise that (1) decay in stored grapes is caused primarily by in-fections that occur in the vineyard before harvest, but which have not developed far enough to be de-tected and removed during pack-ing, and (2) that fumigation kills only fungus spores on the surface of the berries and not the fungi that have entered the berries before harvest. These fungi continue to grow within individual berries during storage despite fumigation. The fumigation does, however, re-duce the occurrence of new infec-tions due to spread of decay from diseased to sound berries.

Method

Applying these principles to measuring infections present in grapes at harvest, the amount of decay that will develop in storage can be predicted. It is important, however, that only field infections be measured and not infections that might occur after harvest, which are largely controlled by sulfur dioxide fumigation.

The forecast is made by taking a sample of individual berries from each lot of grapes to be tested. The sample is placed in glass jars and is fumigated with sulfur dioxide to kill all surface contamination. After fumigation, the jars are covered and the fruit is held under sterile conditions at high humidity and at room temperature. Under these conditions, decay develops within 10 days that would require several months to develop in cold storage. By calculating the percentage decay occuring in the test sample, the amount of decay that will develop during storage in corresponding lots can be predicted.

Unless the sample is representative, the forecast would provide an erroneous idea about decay in the particular lot being tested. Under experimental conditions samples are taken from marked vines randomly situated in each of the vineyards being tested. Fruit from these vines is picked at weekly intervals through the normal harvest season and taken to the laboratory. A portion of the fruit from each lot is used for the forecasting test and the remainder is placed in cold storage for approximately 3 months. With this method of sampling there is a correlation between the percentage decay that develops in the forecasting test and that which subsequently develops in corresponding lots in storage (Figure 19, *A*, *B*).

Under commercial conditions samples can be taken by clipping individual berries from the packed lugs of grapes as they pass along the conveyor toward the lidding machine. This method of sampling provides a good measure of the potential decay present in specific lots of grapes going into storage and requires less time and labor than collecting the samples in the vineyard. However, when grapes are packed in the field, it may be more practical to collect samples in the vineyard as is done experimentally.

Effect of Harvest Date

Since field infections normally increase as the season progresses, the forecast indicates the harvest date after which grapes should not be held for long-term storage. In years when heavy rains occur during the harvest, this date is fairly obvious. However, in other years when light rains, periods of high humidity, or heavy morning dew or fogs occur, their effect on infection may not be recognized. The forecast measures infections due to all these factors.

Effect of Source of Storage Lot

The amount of decay in storage varies with lots harvested from different vineyards or districts. In years when no rain occurs during the harvest season, this factor may be the principal source of variation in decay between lots. However, variation in decay between vineyards is also important in seasons when the fruit is exposed to heavy rains. Grapes in certain vineyards are capable of withstanding adverse weather conditions without severe decay losses, while others suffer decay after exposure to only mildly unfavorable weather conditions. To detect these variations the forecasting test is particularly useful (see section on decay for discussion of the factors related to infection).

Application of Forecast

The forecasting test provides a relatively precise method for the selective marketing of storage lots according to their decay potential. If a high percentage of decay in a given lot is indicated by the forecast, the shipper can market this lot early, before decay has a chance to develop. If the forecast indicates that a particular lot is sound, that lot can be held safely in storage to take advantage of favorable markets late in the storage season (*27*, *28*).

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Appendix

Calculation of the Refrigeration Requirements of a Theoretical Plant

When planning a new plant or letermining the capacity of an xisting one all sources of heat have o be considered. As an example onsider the refrigeration requireients of the following theoretical lant:

Plant Design and Operation

A single-story storage plant adoins a packing room and contains hree 40- by 50-foot storage rooms rith 18-foot ceilings for multipleallet stacking. Each storage room vill hold approximately 22,000 lugs f grapes. The plant also contains wo 22- by 26-foot precooling ooms with 12-foot ceilings, each of vhich hold 4,000 lugs of fruit. Since the maximum capacity of the acking room is 4,000 lugs of grapes er day, one precooling room is lled each day during the peak seaon. The precooling period is 24 ours and, during the warmest part f the season, fruit temperature is educed from an average of 80° F. to 6° F. during precooling. At the nd of the harvest season the plant ontains a peak storage load of 4,000 lugs. The plant is mechaniilly refrigerated with individual oom dry-coil bunkers. Each storge room has five ½-horsepower fan iotors which deliver air at a total ate of 22,500 c.f.m. Each precoolig room has three 1½-horsepower an motors which, when operated or precooling, move a total of 7,000 c.f.m of air. Exterior walls re insulated with 6 inches and the eiling with 8 inches of shredded edwood bark. The floor has 4 inches of corkboard beneath the concrete wearing surface.

Refrigeration Requirements

The refrigeration requirements of this plant when operated at capacity would be as follows:

	B.t.u.
Removal of field heat:	
24 hours in precooling room.	
Fruit, 4,000 lugs reduced 44° F.	
44 (°TR) × 112,000 (lbs.) × 0.82 (S)	4,040,960
Boxes, 4,000 lugs reduced 44°.	
44 (°TR) × 16,000 (lbs.) × 0.33 (S)	232,320
24 hours in storage after precooling.	
Fruit, 4,000 lugs reduced 5°.	
5 (°TR) × 112,000 (lbs.) × 0.82 (S)	459,200
Boxes, 4,000 lugs reduced 5°.	
5 (°TR) × 16,000 (lbs.) × 0.33 (S)	26,400
Total field heat per day	4,758,880
Heat of respiration:	
4,000 lugs of Thompson Seedless during precooling at an average temperature of 53° F.	
56 (tons) × 1,690 (B.t.u. per ton per day)	94,640
30,000 lugs of Thompson Seedless in storage during peak of receiving season, average 32°.	
420 (tons) × 430 (B.t.u. per ton per day)	180,600
Total vital heat per day during packing season	275,240
74,000 lugs of Emperor in storage at end of packing season, average 32°.	
1,036 (tons) × 350 (B.t.u. per ton per day)	362,600

	B.t.u.
Heat leakage:	
Exterior wall surfaces, 7,920 square feet.	
7,920 (sq. ft.) × 48 (°TD) × 1.03 (B.t.u. per day)	391,565
Ceiling surface, 7,144 square feet.	
7,144 (sq. ft.) × 54 (°TD) × 0.77 (B.t.u. per day)	297,048
Floor surface, 7,144 square feet.	
7,144 (sq. ft.) × 35 (°TD) × 1.6 (B.t.u. per day)	400,064
Total heat leakage per day	1,088,677
Air infiltration:	
One 8 x 8 foot outside door in each room.	
Storage room doors are open average of 2 hours daily.	
Precooling room doors are open average of 4 hours daily.	
14 (open-door hrs.) × 250,000 (B.t.u. per hr.)	3,500,000
Other heat sources:	
Electric fan motors, 15 ½-HP and 6 1½-HP.	
16.5 (total HP) × 3,000 (B.t.u. per hr.) × 24 (hrs.)	1,188,000
Electric lights, 32 200-w lamps.	
6.4 (KW) × 3,500 (B.t.u. per hr.) × 6 (hrs.)	134,400
Workmen, 2 for 8 hours per day.	
2 (men) × 1,000 (B.t.u. per hr.) × 8 (hrs.)	16,000
2 (1-ton electric fork truck × 35,000 (B.t.u. per 8 hrs.)	70,000
Total from incidental sources per day	1,408,400
Recapitulation:	
Field heat (peak load)	4,758,880
Heat of respiration (receiving period)	275,240
Heat leakage through external surfaces	1,088,677
Air infiltration (peak load)	3,500,000
Other heat sources	1,408,400
Total	11,031,197

11,031,197 (B.t.u.) ÷ 288,000 (B.t.u. per ton) = 38.3 tons of refrigeration.

September 1959
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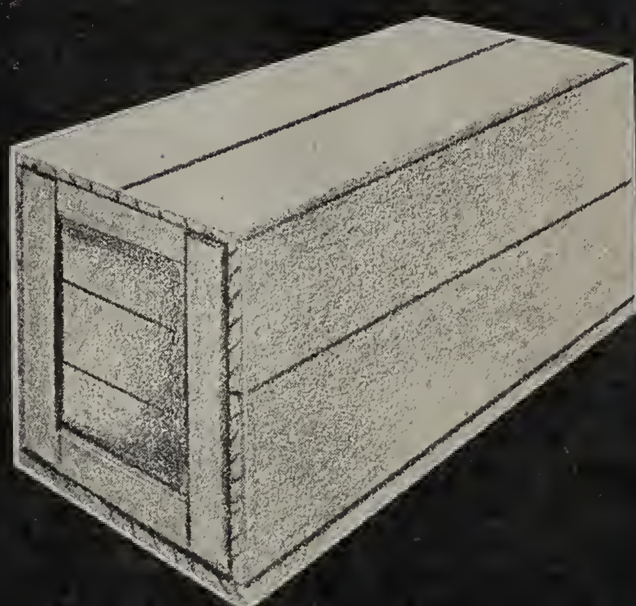
NAILING BETTER WOOD BOXES AND CRATES



y L. O. Anderson

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CONTENTS

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Nailing Better Wood Boxes and Crates

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Forest Products Laboratory,[1] Forest Service, U.S. Department of Agriculture

INTRODUCTION

The strength and stability of wood containers depend primarily on adequate methods of fastening. This has been shown by extensive packaging research conducted at the Forest Products Laboratory as a part of its program to improve the serviceability and utility of wood products.

Containers made of wood can be assembled with a variety of fastenings, including nails, staples, screws, lag screws, bolts, and adhesives. Because nails are the most commonly used fasteners in box and crate construction, their proper use is stressed in this handbook.

Nails are used to fabricate and assemble many styles of boxes and crates. Two typical box styles and two styles of crates are cited in this handbook to illustrate the principles of fabrication with nails. These are the nailed wood box commonly called style 2 in specifications, and the cleated plywood box (fig. 1), the sheathed crate (fig. 2), and the open crate (fig. 3). The nailing methods used to make these containers are adaptable to many other styles, since good nailing principles vary little.

The two basic procedures in box and crate construction are fabrication nailing and assembly nailing. Fabrication nailing means the nailing of box or crate parts. Examples are the nailing of cleats to the end boards of boxes, or sheathing to the frame members of a sheathed crate panel. Normally in fabrication, the nails are driven through both members and clinched, unless the total thickness of the members is too great. Assembly nailing means the assembly of the sides, top, bottom, and ends of a nailed wood box, or the various panels of a crate, to form the finished container.

Containers properly nailed with the right kinds and sizes of nails will be dependably strong and rigid. Containers improperly nailed may fail even though wood members of adequate size and high qual-

[1] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

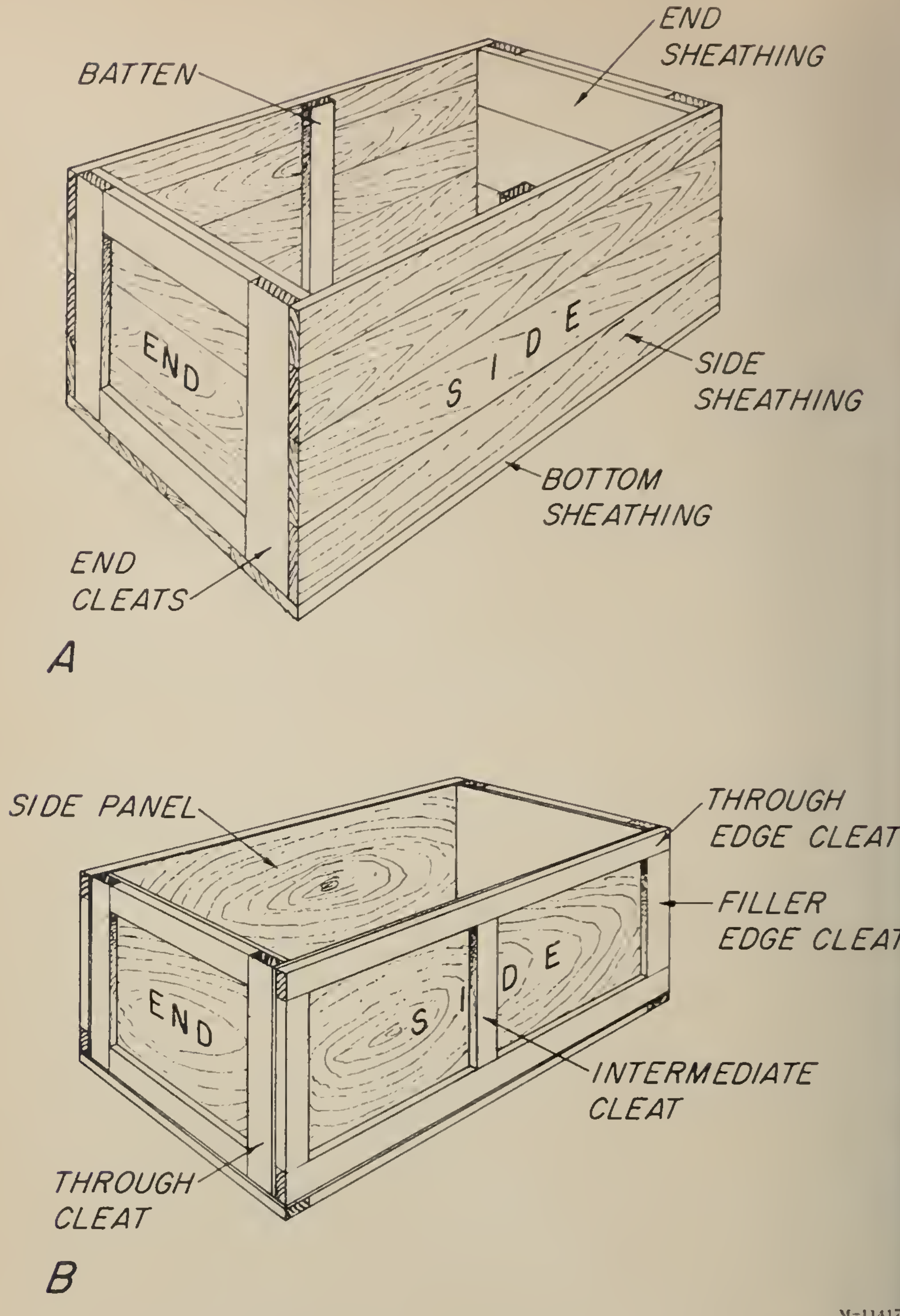

FIGURE 1.—Typical wood boxes: *A*, Style 2 nailed wood box; *B*, cleated panel box.

ity are used. Adequate nailing means not the use of a large number of nails but rather the use of the correct sizes, numbers, and types of nails at the right places. The purpose of this publication is to describe the most important aspects of good nailing for wood boxes and crates.

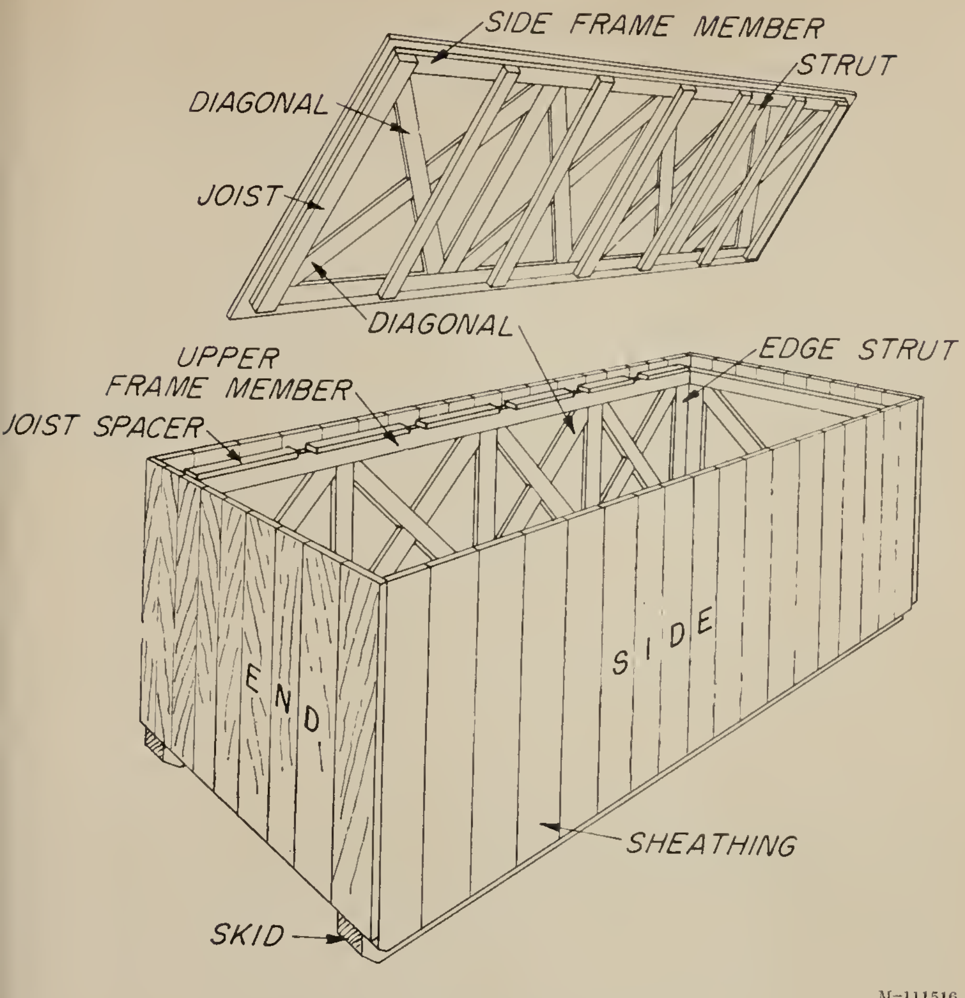

FIGURE 2.—Typical lumber-sheathed crate.

TYPES AND SIZES OF NAILS

Types of Nails

Nails are available in such great variety that they can be used for nost any purpose requiring fasteners. These nails are made in uny sizes and shapes, from steel, aluminum, copper, and other tals. Not all types, however, are satisfactory for boxes and crates. me of the more common types used in containers are shown in ure 4.

Common and Box Nails

Common nails and smooth box nails are most often used in fabri- ion nailing where clinching is required. A nail that is to be iched need not be coated nor given any other treatment to increase withdrawal resistance. Common and box nails have the same gth, but the box nail is smaller in diameter (table 1).

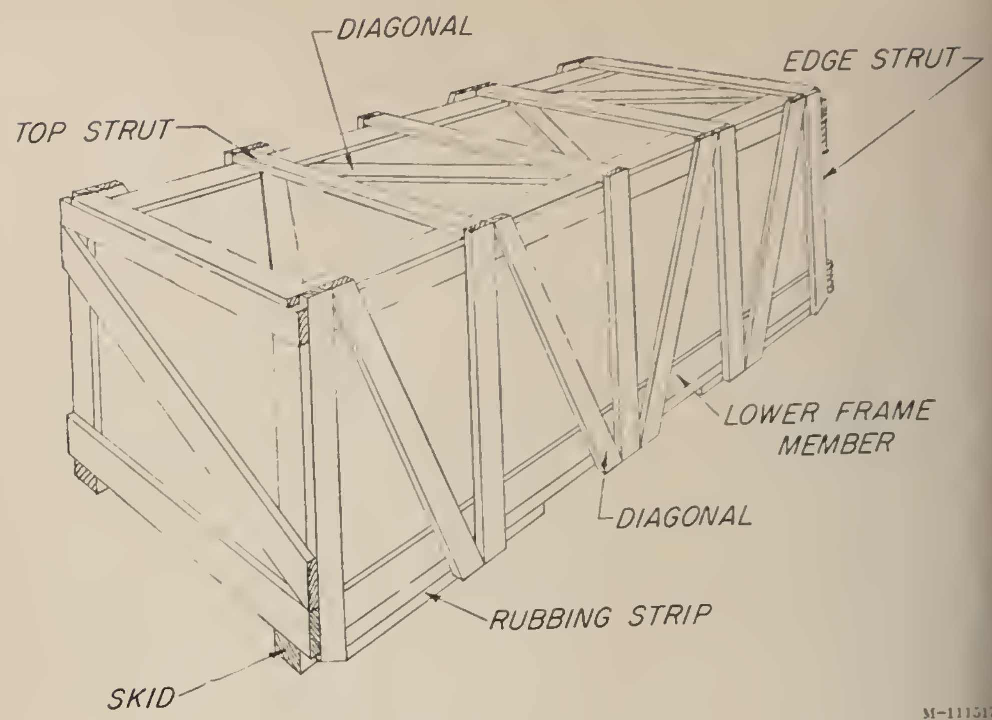

FIGURE 3.—Typical open crate.

Clout nails are commonly used to fasten plywood or other sheet materials to cleats of boxes or to thinner frame members of crates. These nails, available in lengths from 3/4 to 1 1/2 inches, have long, tapered, duckbill points that clinch easily (fig. 4), and larger heads than other container nails of comparable length.

Cement-Coated Nails

Cement-coated nails are steel nails with a resin or similar coating that increases their withdrawal resistance. These nails are the most common type used in the assembly of boxes and crates. Cement-coated nails can be obtained in a variety of sizes and diameters; the most common types are sinkers, coolers, and box nails (fig. 4). Corker nails are also available with cement coating, although not often used for box and crate construction.

Etched Nails

Etched nails are bright steel nails (fig. 4) that have been treated in a chemical solution developed at the Forest Products Laboratory to roughen the surface and thereby increase withdrawal resistance. The surface does not deteriorate as much as the coating on cement-coated nails. Any steel nail may be treated with this solution.

Clean, bright nails can be effectively etched. Remove any lubricant on the nails before treatment.

A B C D E F G H

M-113736

FIGURE 4.—Nail types: *A*, Common; *B*, clout; *C*, sinker (cement-coated); *D*, cooler (cement-coated); *E*, box (cement-coated); *F*, etched; *G*, spirally grooved; *H*, annular-grooved.

Etching is done as follows:

(1) Prepare a 10 percent solution (by weight) of commercial nonoammonium phosphate in water. Do not use a metal container o prepare or store the solution. Keep the solution at room temperature, approximately 70° F. Five gallons of solution are sufficient to etch 100 pounds of nails.

(2) Immerse the nails in the solution for about 7 hours and stir occasionally to change the position of the nails for more uniform reatment.

(3) At the end of the etching period, remove the nails from the olution, rinse them thoroughly in water, and dry them to prevent usting.

Other roughened-shank nails with somewhat increased withdrawal esistance include sandblasted, parkerized, and galvanized nails. Galvanized, stainless steel, aluminum, copper, and brass nails are sed in special containers intended for service under severe shipping nd storage conditions where rust must be avoided.

Deformed-Shank Nails

Deformed-shank nails retain a great percentage of their withrawal resistance even after the wood has undergone many changes n moisture content. The two most common varieties of deformedhank nails are the spirally grooved nail, which has a series of pirals around its shank, and the annular-grooved nail, which has

TABLE 1.—*Dimensions and number per pound of standard sizes and kinds of nails commonly used for boxes and crates*

Size of nail [1]	Bright		Cement-coated			
	Common	Box	Corkers	Sinkers	Coolers	Box
LENGTH IN INCHES						
2d	1	1			1	
3d	1¼	1¼		1⅛	1⅛	1⅛
4d	1½	1½		1⅜	1⅜	1⅜
5d	1¾	1¾		1⅝	1⅝	1⅝
6d	2	2	1⅞	1⅞	1⅞	1⅞
7d	2¼	2¼		2⅛	2⅛	2⅛
8d	2½	2½	2⅜	2⅜	2⅜	2⅜
9d	2¾	2¾	2⅝	2⅝		2⅝
10d	3	3	2⅞	2⅞	2⅞	2⅞
12d	3¼	3¼		3⅛		
16d	3½	3½		3¼		
20d	4	4	3⅞	3¾		
GAGE [2]						
2d	15	15½			16	
3d	14	14½		15½	15½	16
4d	12½	14		14	14	15½
5d	12½	14		13½	13½	15
6d	11½	12½	12½	13	13	13½
7d	11½	12½		12½	12½	13½
8d	10¼	11½	11	11½	11½	12½
9d	10¼	11½	11	11½		12½
10d	9	10½	10	11	11	11½
12d	9	10½		10		
16d	8	10		9		
20d	6	9	7	7		
APPROXIMATE NUMBER OF NAILS PER POUND						
2d	830	1,010			1,094	
3d	528	635		850	848	988
4d	316	473		495	488	710
5d	271	406		364	364	522
6d	168	236	232	275	275	310
7d	150	210		212	212	283
8d	106	145	129	142	142	191
9d	96	132	114	130		172
10d	69	94	84	104	104	118
12d	63	88		77		
16d	49	71		61		
20d	31	52	36	37		

[1] Nails are available in sizes up to sixtypenny. Bolts are usually preferred in boxes and crates, however, where nails larger than twentypenny would be required.

[2] Conformed to the American Steel and Wire Company steel wire gage.

small grooves around its perimeter (fig. 4). In general, annular-grooved nails sustain larger static-withdrawal loads and spirally grooved nails sustain greater impact-withdrawal loads than do other nails.

Nail Points and Heads

Diamond-pointed nails are perhaps most commonly used in container construction. The clout nail has a duckbill point that is easily clinched because of its taper. Some special nails have a needle point or a chisel point. A sharply pointed nail will cause splits in denser woods. To minimize these splits, slightly blunt the point of the nail before it is used. When only a few nails are needed, blunt them with a hammer. Blunting on an emery wheel is more practical when a large number are needed.

Nailheads vary somewhat in diameter and thickness (fig. 5). The flat head is used for the common nail, the cement-coated cooler, and other similar nails. The countersunk head, used for the sinker nail, provides additional strength and does not break off easily. The cement-coated box nail has a broad, flat head. Do not use this type of nail in dense hardwood, or where an uneven blow may shear off the head.

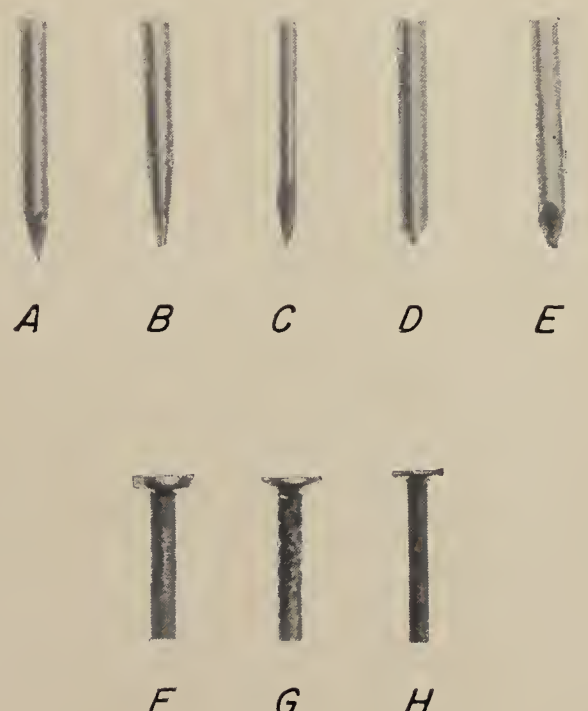

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FIGURE 5.—Nail points and heads: *A*, Diamond; *B*, needle; *C*, duckbill; *D*, chisel; *E*, blunted; *F*, flat; *G*, countersunk; *H*, broad flat.

Nail Sizes

The size of most nails, particularly those used for containers, is based on their length; the diameter or gage varies with length and nail type. The usual designation for these nail sizes is expressed by the "penny" system, abbreviated as "d." Thus, a sixpenny nail is expressed as 6d, and an eightpenny as 8d. The penny system originated in England, where it is said to have been based on the weight of a thousand nails; that is, 1,000 tenpenny nails weighed 10 pounds and 1,000 eightpenny nails 8 pounds.

Bright common nails and box nails are of the same length, but box nails are smaller in diameter for a given penny size (table 1). Among cement-coated nails, sinker nails are available in the greatest range of sizes. In sizes less than tenpenny, the four types of cement-coated nails are of the same length for each penny size. These nails are ⅛ inch shorter than bright common nails and box nails of equivalent penny size (table 1). Bright box nails are larger in diameter than cement-coated box nails of equivalent penny size.

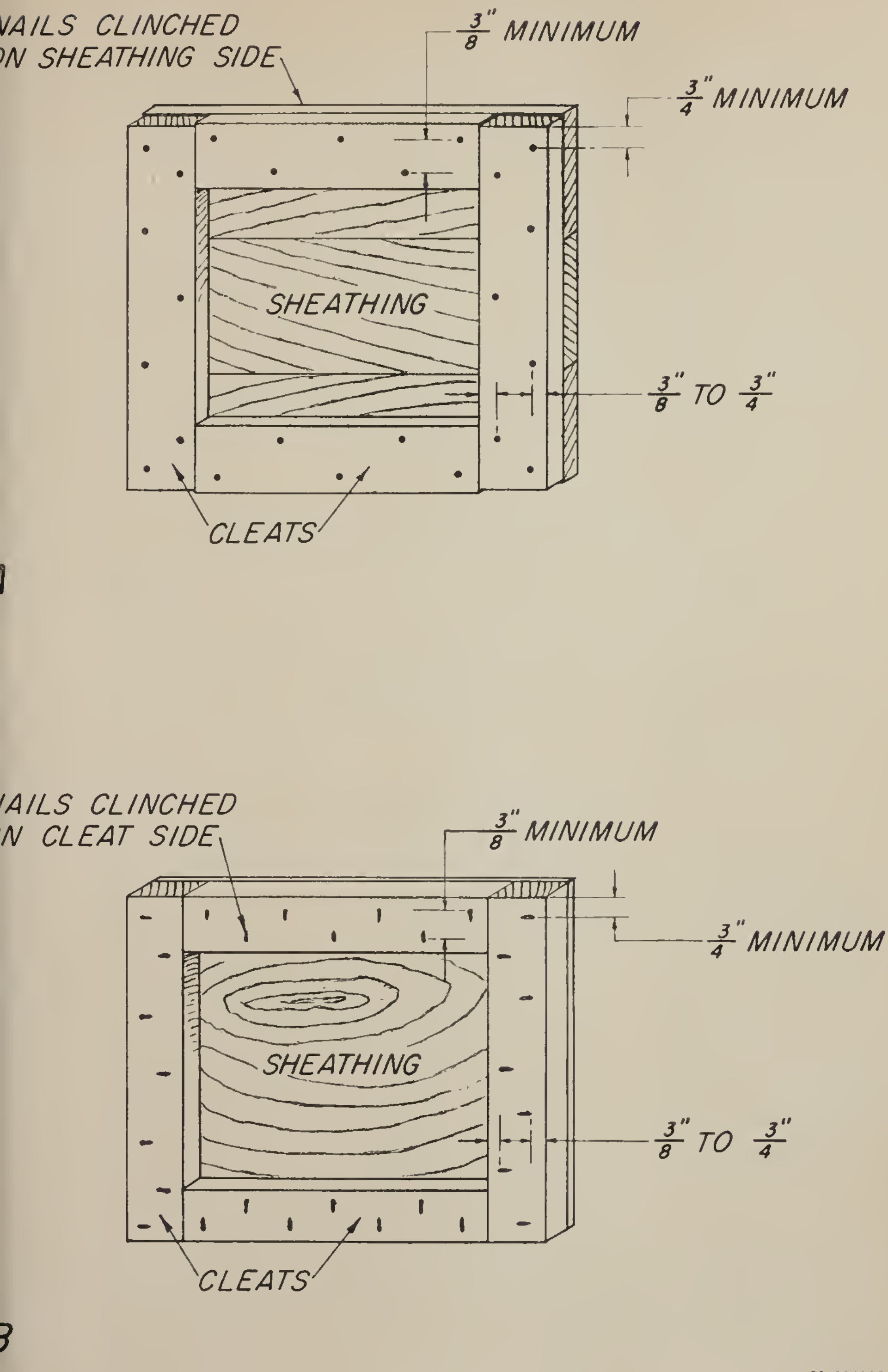
HOW TO NAIL A WOOD BOX

Generally speaking, box manufacturers use automatic nailing machines as much as possible. These machines drive and clinch a number of nails at one time and can be readily adjusted for the fabrication of box parts of various sizes. They are also used to fasten the sides and bottom of the box to the ends; the top is often nailed on by hand after the contents are packed. The fabricated box parts that form complete units are called "box shook" and are shipped to the user in knocked-down form. The nailing principles discussed here for the fabrication and assembly of two common styles of boxes may be adapted to almost any similar container.

Nailing of Cleats and Battens

Ends of nailed wood boxes and panels of cleated panel boxes are usually fabricated with nails that are driven through both the cleat, or batten, and the sheathing and then clinched (fig. 6). Nails should be long enough to allow for proper clinching. This extra length should be at least ⅛ inch for fourpenny and smaller nails, ¼ inch for fivepenny, sixpenny, and sevenpenny nails, and ⅜ inch for eightpenny nails. Longer nails require a longer clinch because of their greater diameter. Clout nails, however, should be clinched at least ¼ inch because of their thin, tapered, duckbill point.

These recommendations are based on the strength advantage of an adequate clinch. Too long a clinch is undesirable because of the difficulty of burying the nail point and the end of the shank into



GURE 6.—Nailing patterns and spacings for box ends of *A*, a nailed wood box, and *B*, a cleated panel box.

e wood. Clinching across rather than parallel to the grain of the ood is recommended because it gives 20 percent greater withrawal resistance.

Nails are usually clinched against the sheathing. However, in cleated panel boxes made with plywood or some other sheathing material that is too thin, it is best to clinch against the cleats for greater strength. Clinching makes it especially important to select nails with heads that will not shear off when they are driven. Such nails include sinkers, coolers, corkers, and common nails. Common nails and sinker-type nails are often used and are a good choice because they are available in many lengths. Sinker nails have strong countersunk heads that prevent their breaking off when used in hardwoods.

In nailing plywood, fiberboard, or other sheathing material to the cleats, use nails with heads large enough in diameter to prevent their being pulled through the sheathing. These nailheads should also be thick enough so that they will not shear off. In box construction, use a nail with a head not less than 7/32 inch in diameter, especially in fiberboard, paper-overlaid veneers, and the thinner plywoods. Various types of nails, in the sizes and shank gages commonly used to make cleated panel boxes, are shown in table 2.

TABLE 2.—*Types of nails often used to fasten sheathing to cleats of cleated panel boxes*

Nail type	Size	Length	Gage	Head diameter
	Penny	*Inches*		*Inches*
Box (smooth)	3	1¼	14½	7/32
	4	1½	14	7/32
	5	1¾	14	7/32
Clout	----------	¾	15	7/32
	----------	⅞	14	¼−
	----------	1	14	¼−
	----------	1⅛	14	¼−
	----------	1¼	13	¼+
	----------	1⅜	13	¼+
	----------	1½	13	¼+
Sinkers	5	1⅝	13½	7/32
Coolers	4	1⅜	14	7/32
	5	1⅝	13½	15/64
Common	4	1½	12½	¼
	5	1¾	12½	¼

The nails used to fasten the sheathing of nailed wood boxes and cleated panel boxes are driven in a two-row staggered pattern (fig. 6). For nailed wood boxes, the recommended spacing of nails in each row is as follows:

Nail size (penny):	*Average spacing (inches)*	Nail size (penny):	*Average spacing (inches)*
6 or smaller	2	10	3
7	2¼	12	3½
8	2½	16	4
9	2¾		

Space rows of nails not less than 3/8 inch apart; 3/4 inch or more s better if the cleat is wide enough, particularly with the larger ails, in order to avoid cleat splitting. In wide cleats, each row hould be about 3/4 inch from the nearest edge. Space nails evenly long the length of the cleat. The first nail at either end of the leats should not be closer than 3/4 inch nor farther than 1½ inches rom the cleat end (fig. 6). Nail each board in an end panel to ach vertical cleat with at least two nails.

Nail interior battens for the sides, reinforcing cleats, diagonals, nd similar members of wood boxes as described for end cleats.

The cleats in cleated panel boxes should be nailed as described or the ends of the nailed wood box, but space the nails in each row ot more than 6 inches apart.

Assembly Nailing of Boxes

Assembly nailing of a box requires the use of coated nails or nails ith roughened or deformed shanks to increase withdrawal resist- ice. The nails should have strong heads of sufficient size to pre- ent them from pulling through the wood or breaking off. The pes used for box part fabrication—such as sinkers, coolers, and rkers—are satisfactory.

Nailed Wood Boxes

Although no definite assembly procedure need be followed, the gical first step is to nail the sides of a box to the ends. Nail the le sheathing of nailed wood boxes to the ends (fig. 7). The nails e placed in a staggered pattern by alternately nailing into the end eat and the end sheathing.

A good rule to follow in selecting nails of proper size is that the il be long enough to penetrate at least 2 to 2½ times the thick- ss of the sheathing or the fastening members. Table 3, which ts nail sizes for box assembly purposes, gives data of value in ecting the proper nails for low- and high-density woods accord- g to the grouping by species shown on page 39.

Place the first nails in the top and bottom boards of the side eathing at about one-half the spacing distance (designated on ge 10) from the edges (fig. 7). This distance may vary a little cause of knots, checks, or the location of fabrication nails. Drive least two nails at each end of each board of the sides.

For nailed wood boxes, space the nails as shown on page 10. If sheathing frequently splits, nails one penny smaller can be used l spaced one-fourth inch closer than is specified on page 10 for ls of the size actually used.

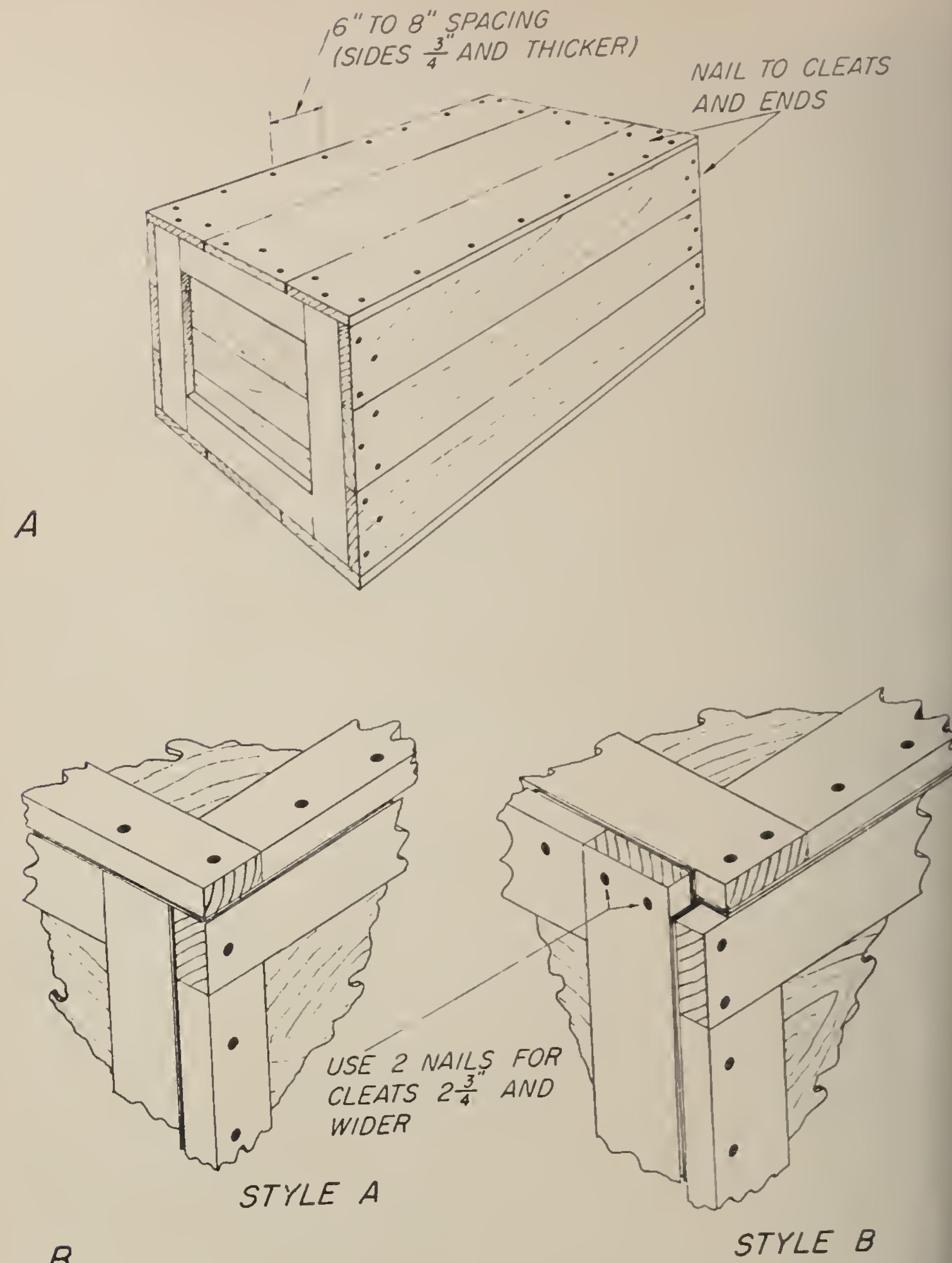


FIGURE 7.—Assembly nailing patterns for *A*, nailed wood box, and *B*, cleate panel boxes.

The bottom and top sheathing boards are nailed to the end sheath ing and end cleats in the same general manner described for th sides.

Top and bottom boards are sometimes nailed to the side sheathin when the thickness of the side sheathing is at least three-fourths an inch. Sevenpenny nails are used for side sheathing less than inch thick and eightpenny nails for thicker side sheathing. Spa nails about 6 to 8 inches apart (fig. 7).

TABLE 3.—*Nail sizes recommended for assembly of nailed wood boxes made of woods grouped for density* [1]

Thickness of sheathing (inches)	Size of nails			
	Group I woods	Group II woods	Group III woods	Group IV woods
	Penny	*Penny*	*Penny*	*Penny*
3/8	6	5	5	4
1/2	7	6	5	5
5/8	8	7	6	6
3/4	9	8	7	6
7/8	10	9	8	7
1 to 1 1/8	12	10	9	8

[1] Group I, soft woods; II, hard coniferous woods; III, medium density hardwoods; IV, heavy hardwoods.

Cleated Panel Boxes

Assembly nails used to attach the ends of cleated panel boxes cannot be placed in a staggered pattern; all must be driven into the edge cleats (fig. 7). This type of nailing may cause the cleat to split if the nails are too large or the nail spacing is too close. The choice of nail length should be based on the combined thickness of the panel material and the cleat. The penetration of the nail into the edge of the cleat should be about twice this combined thickness. Table 4 gives nail sizes and spacings recommended for nailing side, top, and bottom panels to the ends, and the top and bottom panels to the sides. However, nails should not be so long that they penetrate the opposite edge of the cleat.

Space assembly nails evenly, and use at least one nail in the end of each cleat that is less than 2¾ inches wide; in wider cleats, use 2 nails (fig. 7).

TABLE 4.—*Nail size and spacing for assembly of cleated panel boxes*

Combined thickness of panel and cleat (inches)	Size of nails		Spacing of nails (all wood groups)
	Group I and II woods	Group III and IV woods	
	Penny	*Penny*	*Inches*
[illegible]/4	8	7	5
[illegible]/8	9	8	5
[illegible]	9	8	4½
[illegible]1/8	10	9	4½
[illegible]1/4	10	9	4
[illegible]3/8	12	10	4

Most boxes are reinforced with wire or flat metal tension straps. These straps are placed around the perimeter of a nailed wood box and stapled in place. On cleated panel boxes the straps are placed on the cleat around the top, bottom, and ends. Under most conditions, strapping has some value for nailed wood and cleated panel boxes when properly placed and stapled. However, it presents a snagging hazard when it becomes loose.

Rules for Nailing Boxes

1. Bright nails may be used to fasten sheathing to cleats if the nails are clinched. Use coated, etched, or other types of roughened- or deformed-shank nails, however, if clinching is not done. For lumber sheathing, use common, sinker, cooler, corker, or similar types of nails. For plywood sheathing, use clout nails.

2. Clinch nails across the grain of the wood. Allow a length of clinch of not less than 1/8 inch for fourpenny and smaller nails, 1/4 inch for fivepenny, sixpenny, and sevenpenny nails and clout nails, and 3/8 inch for eightpenny nails. Longer nails may require a 1/2-inch clinch.

3. Fasten cleats or battens of box parts to sheathing with two rows of nails whenever possible. Likewise, place assembly nails in a two-row or staggered pattern when practical.

4. In the fabrication of nailed wood box parts, nail the ends of each end-sheathing board to each vertical cleat with at least two nails.

5. Drive nails so that neither the head nor the point projects above the surface.

6. When nailing sides, top, and bottom to the ends of nailed wood boxes, put at least two nails in each end of each sheathing board.

7. For assembly of sides, top, and bottom to the ends, use nails long enough to penetrate into the ends 2 to 2 1/2 times the thickness of the sheathing.

8. If the desired nail is not available or wood splitting cannot be avoided by slightly blunting the nail point, use the next smaller nail and decrease nail spacing slightly.

9. When two rows of nails are required in the assembly of boxes, drive the nails alternately into the cleat and the sheathing.

10. If the sides are at least 3/4 inch thick, fasten the top and bottom sheathing to the sides with nails spaced 6 to 8 inches apart.

11. When nailing thin plywood, fiberboard, and paper-overlaid veneer to the cleats, use nails with heads at least 7/32 inch in diameter; this will prevent them from pulling through the sheathing.

HOW TO NAIL A WOOD CRATE

Proper fabrication nailing of panels of both open and sheathed ·ates develops the full strength of the crate and its members. In ɔen crates especially, fabrication nailing of panels is critically nportant. In sheathed crates, the fabrication nailing joins adja-ent members by means of sheathing that is securely nailed to all ·ame members.

The construction and appearance of a crate are quite different ·om that of a wood box, but the principles of nailing are similar. abrication of the parts consists of nailing various framing pieces ɔgether, with or without sheathing, to form panels. Assembly con-sts of fastening these panels together to form the container. The zes of nails recommended in this handbook for assembly of crates ·e those generally used for group I and II woods (see page 19). /hen woods of groups III and IV are used, use nails one penny naller for assembly nailing.

Fabrication Nailing of Open Crates

One of the simplest crates to build is the open crate. The key to ɔod fabrication nailing of its panels is effective nail clinching. ecause the sides, ends, and tops of open crates are much alike, the ıme nailing methods are employed for all. The parts of each panel ·e laid on one another and nailed together at the proper places; ıe nails are clinched on the inner face (fig. 8).

The nailing patterns and the number and placement of the nails ıould be such that the full strength of the members is approached. [owever, don't use too many nails, for they may split the wood. he nailing patterns recommended for woods of groups I and II ·e shown in figure 9 for crate members crossing at right angles. 'se at least two nails for each joint. For woods of groups III and V, the number of nails per joint may be decreased by one if the ood splits when the designated number of nails is used. For mem-ɜrs crossing at angles other than 90 degrees, patterns similar to ıose in figure 9 should be used. A detailed nailing pattern for the ıse is shown in figure 10.

Clinch all nails used in the fabrication of open crates, unless the ıember containing the nail point is more than 2 inches thick or the ɔtal thickness of all members exceeds 3 inches. A ¼-inch minimum inch is recommended for sevenpenny and smaller nails; a ⅜-inch inch for eightpenny through twelvepenny nails; and a ½-inch inch for larger nails.

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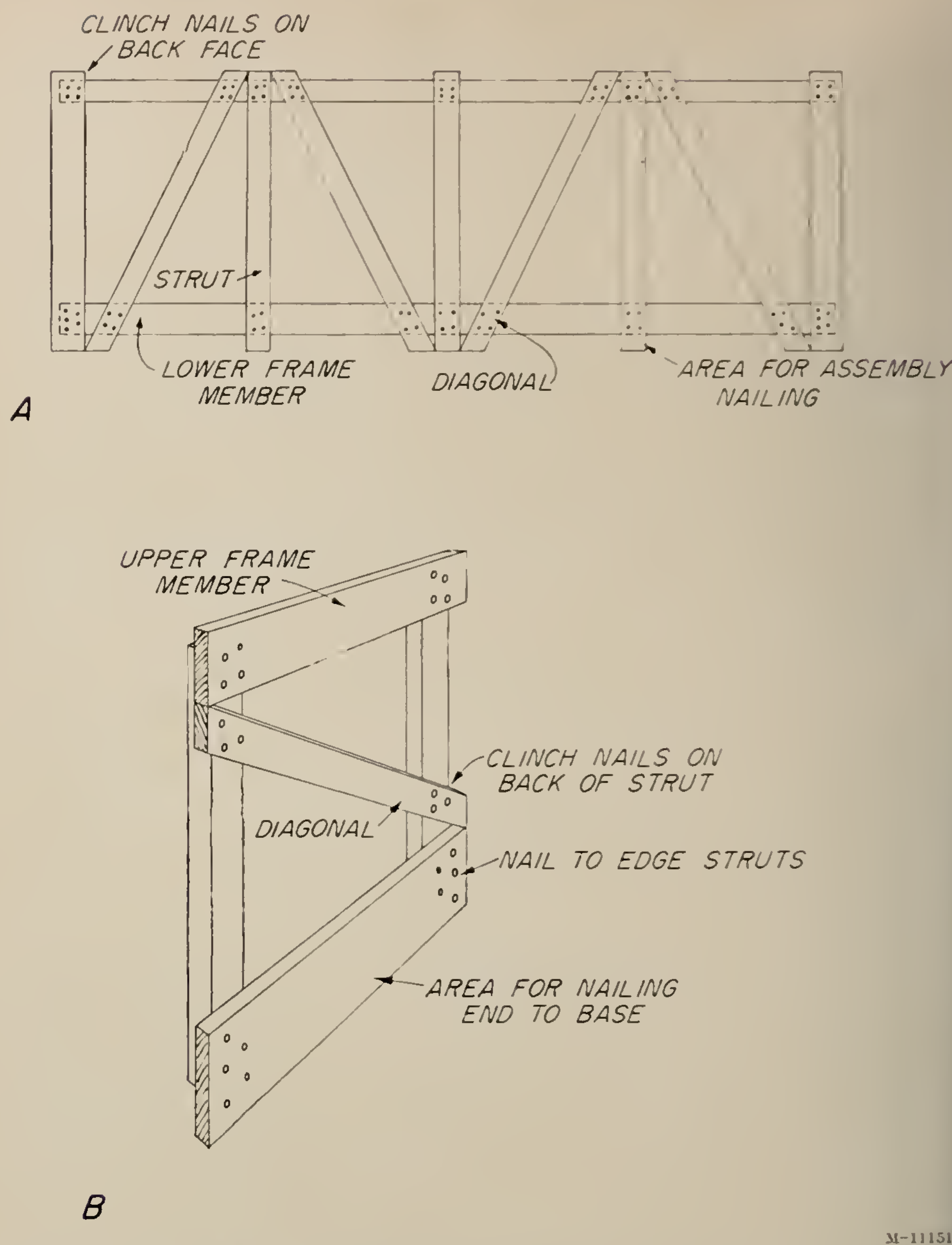
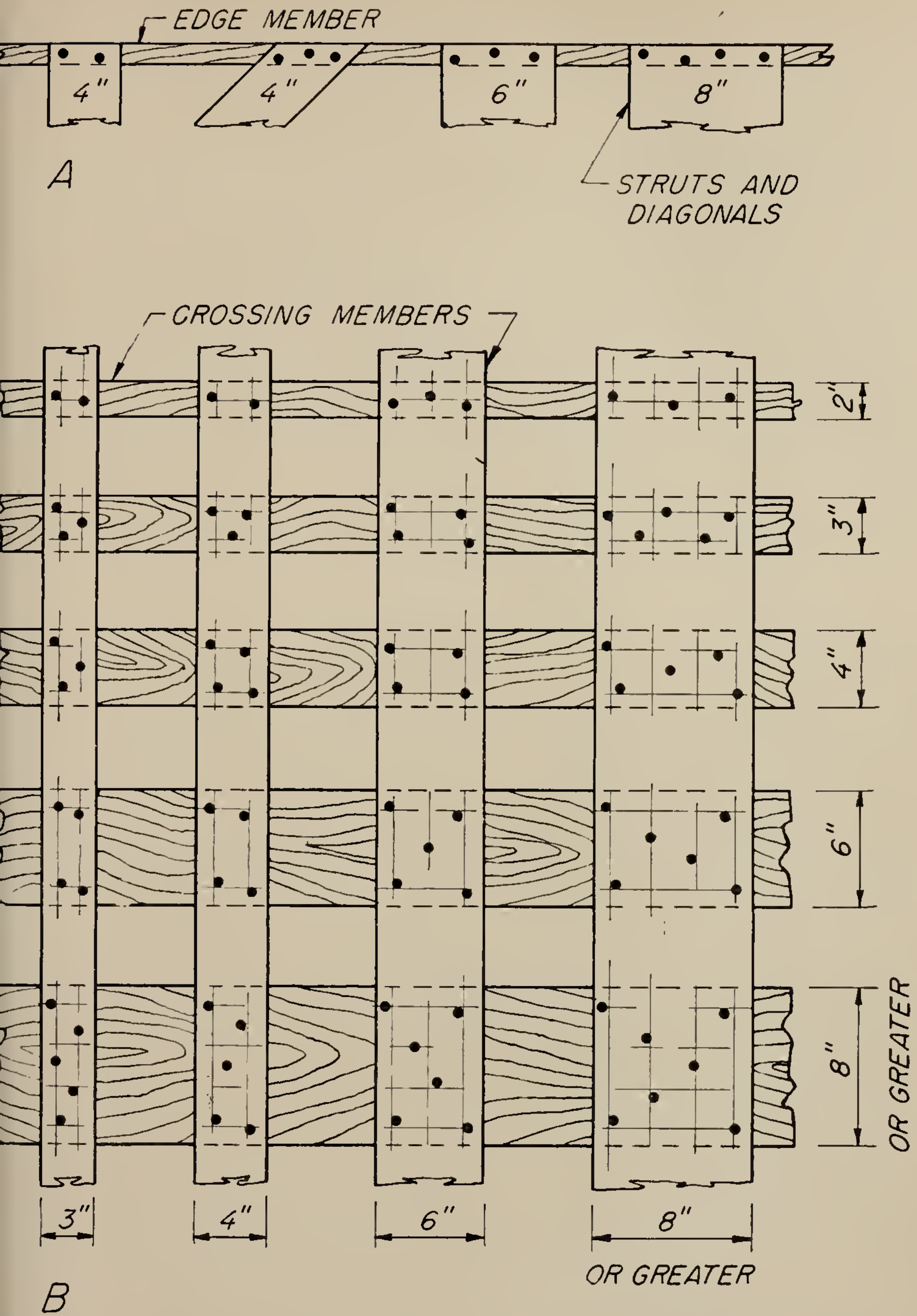


FIGURE 8.—Typical construction for open crates: *A*, Fabrication of sides or top; *B*, fabrication of ends.

Fabrication Nailing of Crate Base

The framing of bases for sheathed and open crates is similar. The cross members, including the end headers and the larger load-bearing floorboards, are usually bolted to the skids (fig. 10). The diagonals, cross members, and lumber and plywood flooring are nailed to the skids. The nailing patterns shown in figure 9 are used to fasten members, except plywood flooring, to the skids. Ply-



GURE 9.—Typical nailing patterns for open crates: *A*, Nailing for assembly of panels to each other; *B*, nailing for fabrication of panels, as used to nail floorboards to skids and lumber sheathing to frame members.

ood flooring is nailed in a two-row staggered pattern, with the ils in each row spaced about 6 inches apart.

The nails should be long enough to penetrate the skid for a disnce 2 to $2\frac{1}{2}$ times the thickness of the member holding the head ithout projecting through, but not less than $1\frac{1}{2}$ inches. Thus, to

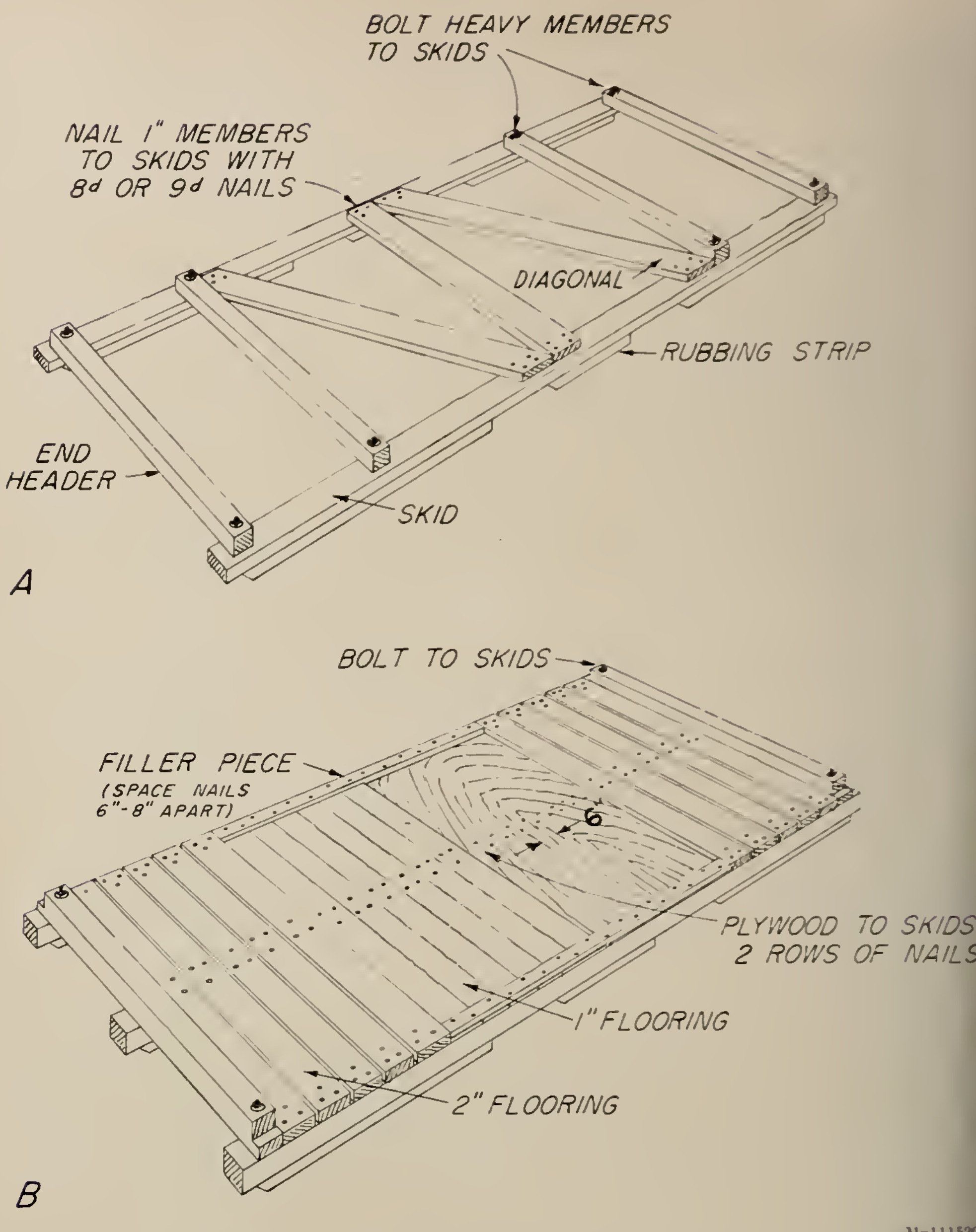


FIGURE 10.—Typical constructions for crate bases: *A*, Base for open crates; *B*, for sheathed crate.

nail a ¾-inch-thick board to a large skid requires a nail about 2¼ to 2⅝ inches long; for example, an eightpenny or ninepenny cement-coated sinker nail, or an etched eightpenny common nail. Under most conditions, these nails have higher withdrawal resistance than plain nails. If, however, clinching is required because the total thickness of all parts is no greater than 3 inches, plain nails are suitable.

Fabrication Nailing for Sheathed Crates

The sides, ends, and tops of sheathed crates are fabricated by placing the precut frame members in their proper positions and fastening them together with corrugated fasteners or staples. When a considerable number of crates of the same size and construction are to be made, jigs are often used to hold the members in position while the sheathing is applied. In lumber-sheathed crates, waterproof paper can be installed between the frame members and the sheathing of side and end panels to seal the joints between sheathing boards. Tops are waterproofed by various means; one effective way is to place waterproof paper between two layers of the lumber sheathing. Plywood-sheathed crates do not require this type of waterproofing, as all plywood joints are made over a frame member and are securely nailed (fig. 11).

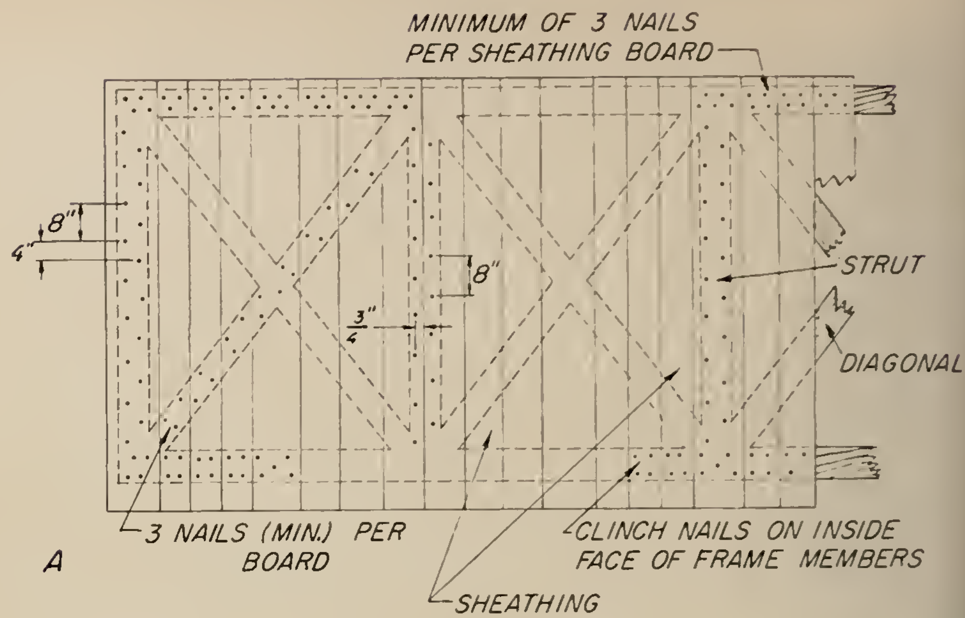
Nails are driven through both the sheathing and the frame members. If the total thickness of the wood is less than 3 inches, the nails are clinched. The length of the clinch depends on the size of the nails required for the joint, and the general rule outlined for open crates should be followed. Coated, etched, or deformed-shank nails recommended for fastening plywood 3/8 inch or less in thickness to 2-inch frame members need not be clinched, but should penetrate to a depth of at least 1 1/2 inches into the frame member.

Figure 11 shows recommended spacing and placement of nails used to fabricate side, end, and top panels of sheathed crates. Drive the nails through the thinner into the thicker member; if these members are of equal thickness, convenience is the controlling factor.

Crate tops often have joists or similar supporting members that are usually installed on edge either before or during crate assembly. Nails are driven through the top sheathing and frame members into the joists. Use two nails where each joist crosses diagonal or longitudinal frame members. Twelvepenny nails are suitable when both sheathing and frame members are nominally 1 inch thick, and tenpenny nails are used with 3/8- or 1/2-inch plywood sheathing. When nailing through a strut of the top into a joist, space the nails about 8 to 10 inches apart.

Assembly Nailing of Open Crates

It is relatively simple to assemble open crates, because there is no great amount of "blind" nailing involved. Most of the nailing is "direct": that is, the pieces holding the nailheads and those holding the points are in plain view (fig. 12). Most nailing, therefore, does not require accurate marking for alinement of the assembly nails. However, it is good practice to indicate by some method the number and placement of the nails.



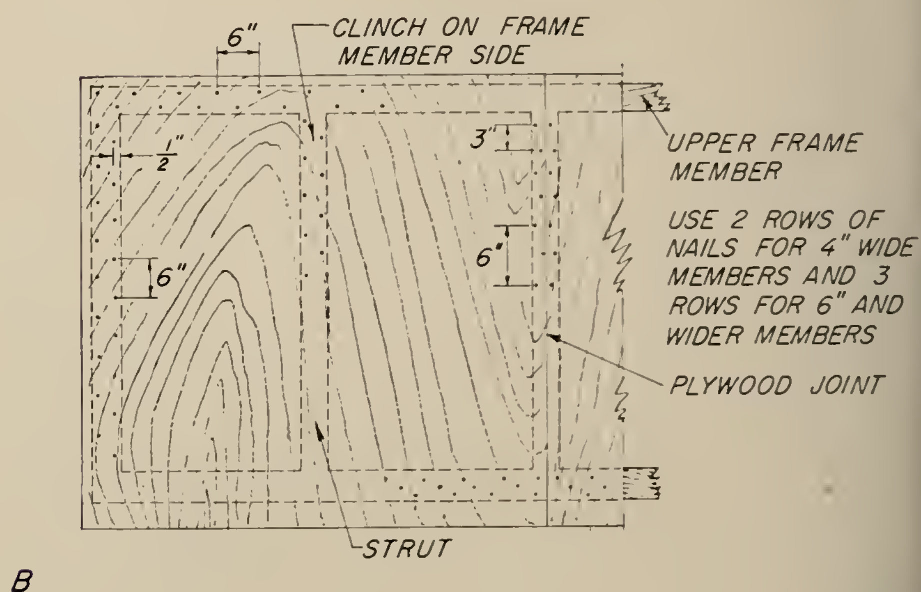


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FIGURE 11.—Typical construction for sides, ends, and tops of sheathed crates: *A*, Lumber-sheathed crates; *B*, plywood-sheathed crates.

Fastening Sides and Ends to Base

Fasten the struts of the side panels to the base by nailing them to the skids or other large base members. Nail diagonals that are in the same plane as the struts and extend below the lower frame member to the skid also. The number of nails used depends on the gross weight of the crate and its contents. In properly designed crates, the greater the weight of the article, the larger the struts, diagonals, and skids; hence greater nailing area is automatically provided.

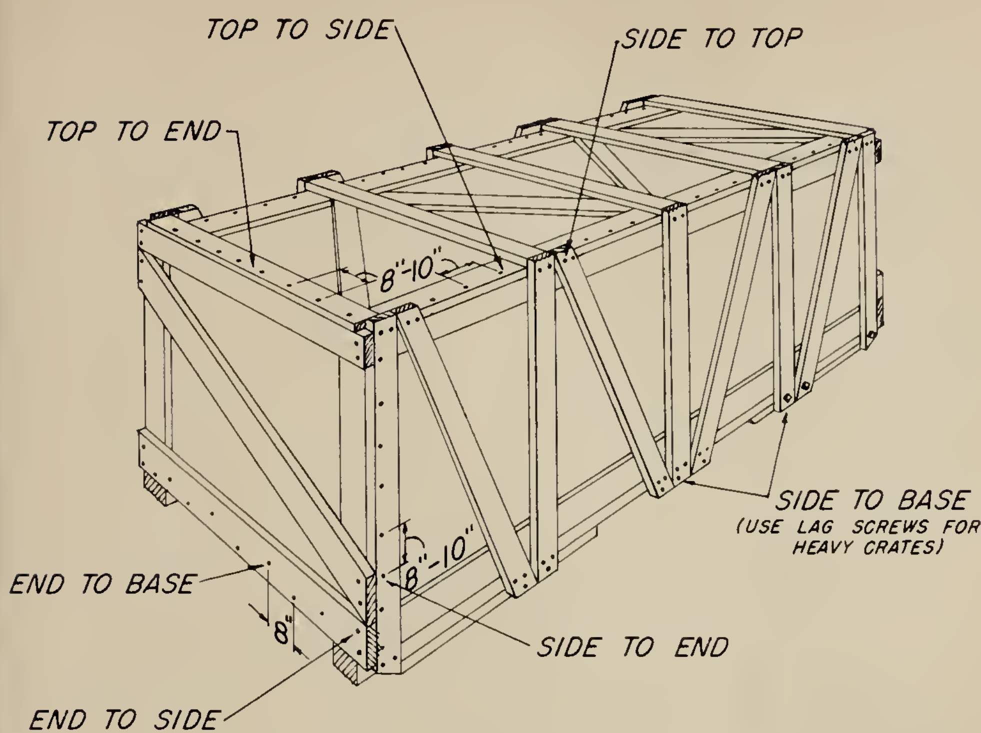

FIGURE 12.—Typical assembly nailing for open crates.

Nail each strut and diagonal of the sides to 2-inch skids with at least three nails for 1 by 4's and four nails for 1 by 6's. When skids are 3 inches deep or more, use at least four nails for 1 by 4's and five nails for 1 by 6 diagonals and struts. Heavy loads or small crates, however, may require a greater number of nails to fasten the sides to the base. The total number of nails required is shown in table 6 by nail sizes and types for various gross loads.

Stagger the nails in patterns similar to those shown in figure 9, and the struts and diagonals nailed to the skids or sills as shown in figure 12. In table 5, eightpenny, ninepenny, and tenpenny nails are listed, any of which may be used to fasten nominal 1-inch members to the base.

For heavily loaded crates, the number of nails required may be so great that their use would not be practical without additional struts and diagonals. Under these conditions, the use of lag screws is recommended. For example, the allowable lateral resistance of a lag screw 3/8 inch in diameter and penetrating 1 1/2 to 2 inches into the skid is at least 4 times that of an eightpenny or ninepenny sinker nail. Thus, two lag screws will do the work of eight nails and require a small total fastening area.

The ends are fastened to the base by nailing the lower frame member of the end to the end header. Eightpenny or ninepenny nails spaced about 8 inches apart are used in a staggered pattern (fig. 12).

TABLE 5.—*Total minimum number of nails required to fasten sides to base of open crates*[1]

Gross load—weight of crate and contents (pounds)	Sinker or cooler nails		Corker nails		Common nails	
	8d and 9d	10d	8d and 9d	10d	8d and 9d	10d
1,000	20	18	18	16	16	14
2,000	38	36	34	30	30	26
3,000	58	54	52	46	46	40
4,000	76	72	68	60	60	52
5,000	96	90	86	76	76	66
6,000	114	108	102	90	90	78
7,000	134	126	120	106	106	92
8,000	152	144	136	120	120	104

[1] Use one-half on each side of crate and divide evenly between struts and diagonals according to their respective widths.

Fastening Sides to Ends and Top

In most open crate designs, the frame members are arranged so that the sides can be fastened to both the end and the top panels. The edge struts of the sides overlap the edge struts of the ends (fig. 12), and the nails should be placed about 8 to 10 inches apart. For nominal 1-inch members, eightpenny or ninepenny nails are driven through the edge struts of the sides.

The upper ends of the struts and the diagonals are fastened to the edge longitudinal members of the top with eightpenny or ninepenny nails (fig. 12). The nailing patterns for open crates shown in figure 9 may be used. Nails placed too near the end often cause boards to split, especially those of the denser woods. Reduce splitting by slightly blunting the ends of the nails. If splitting persists, either predrill nail holes or select nails that are onepenny smaller. If smaller nails are used, more nails will probably be required.

Fastening Ends to Sides

In the design and construction of most open crates, the cross members and the diagonals of the ends extend beyond the edge struts. Nail these to the edge struts of the side panels (fig. 12). Two eightpenny or ninepenny nails are used for 1- by 4-inch members, three nails for 1- by 6-inch members, and four nails for 1- by 8-inch members.

Fastening Top to Ends and Sides

The construction of top panels for open crates differs according to the position of the longitudinal members and the cross members. These variations may change the method of nailing the tops to the

ends. In most cases, the longitudinal edge members of the top are nailed to the upper frame members of the sides (fig. 12). For group I and most group II woods, use eightpenny or ninepenny nails spaced 8 to 10 inches apart.

In panels where the cross members are over the longitudinals, nail the edge struts of the top to the upper frame members of the ends. Use eightpenny or ninepenny nails spaced 8 to 10 inches apart (fig. 12). In top panels where the top longitudinal members pass over the cross struts and diagonals, the upper frame member of the end is fastened to the edge strut of the top with nails spaced 8 to 10 inches apart.

These nailing principles can be applied to many styles of crates other than the basic ones described here.

Assembly Nailing of Sheathed Crates

The assembly nailing procedures recommended for sheathed crates, while similar to those for open crates in some respects, also differ considerably. The reason is that much assembly nailing consists of driving the nails through the sheathing directly into a structural member. There is also more nailing surface. This allows more uniform nail spacing and eliminates the concentrations of nails. The latter, common in open crates, is often the primary cause of splits when the loaded crates are stressed by rough handling during transit.

Sheathed crates can be designed to carry greater loads than open crates. The greater fastening area available allows the use of more nails, which contributes greater resistance to lateral load stresses. In small open crates, for example, only two or three struts may be available to receive nails, but a sheathed crate can be nailed along its entire length. As in all assembly procedures, coated, etched, or deformed-shank nails provide superior withdrawal resistance.

Fastening Sides and Ends to Base

In sheathed crates, the side panels are nailed to the skids and the end panels are nailed to the end headers of the base. When 2- by 4-inch skids or headers are used flat, stagger the nails slightly (fig. 9). If skids or sills 3 or 4 inches deep are used, place the nails in two rows in a staggered pattern; for skids or sills deeper than 4 inches, three rows of nails are used (fig. 13).

Generally, eightpenny and ninepenny nails are used for nominal 1-inch lumber sheathing and ½-inch and thicker plywood, and sevenpenny nails for plywood sheathing less than ½ inch thick. The minimum number of nails for the side-to-base nailing is governed by the gross weight of the crate and its contents. Table 6

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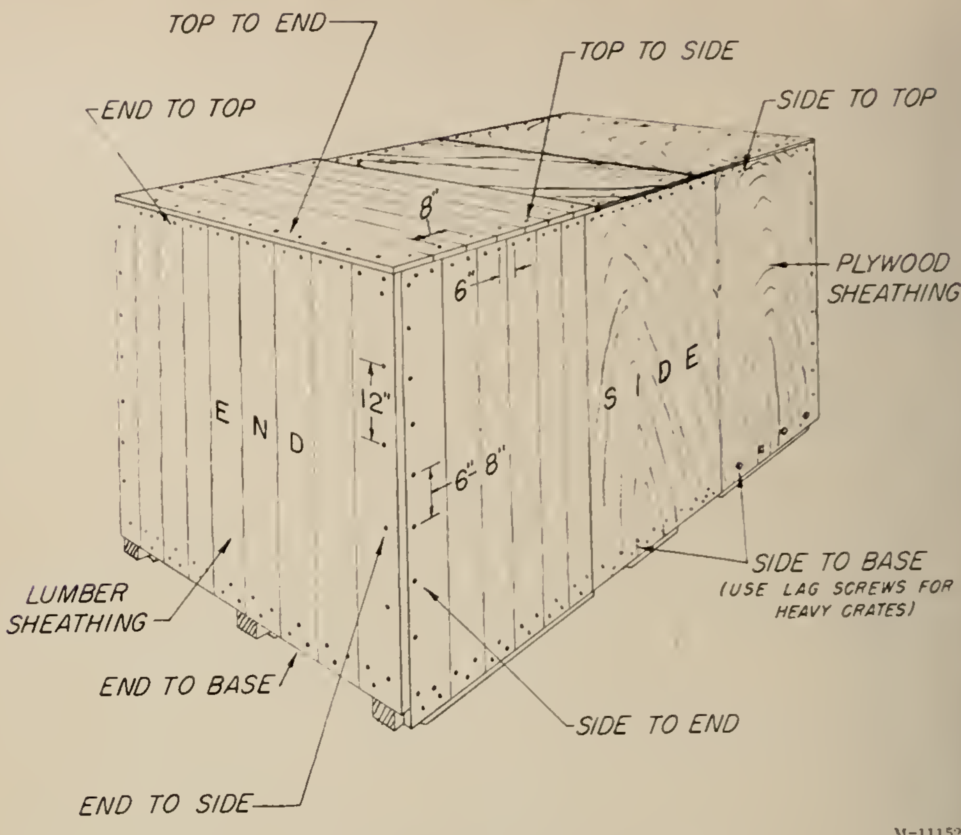


FIGURE 13.—Typical assembly nailing for sheathed crates.

lists, by types of nails and wood groups, the number of nails required for each 1,000 pounds of gross load.

Good practice calls for at least two nails in each lumber sheathing board. In addition, space nails used to fasten sides and ends to the base no farther apart than 3 inches when in single rows, 6 inches in double rows, and 9 inches when three rows are used. Nails spaced too closely will split the sheathing. If nail requirements result in spacing of less than 1½ inches, nails should be replaced with lag screws installed as described for the side-to-base assembly of open crates.

Fastening Sides to Ends

The side panels are fastened to the end panels with nails driven through the sheathing of the sides into the edge struts of the ends. The nails are spaced about 6 to 8 inches apart (fig. 13). Nail sizes are the same as those recommended for side-to-base assembly. The end panel is fastened to the side panel with nails through the sheathing and edge strut of the end into the edge strut of the side. The edge strut of the side is usually a 2-inch or thicker member.

TABLE 6.—*Number of nails*[1] *needed to fasten sides of sheathed crates to base for each 1,000 pounds of gross load, by wood group*

Nail type [2] and size	Group II woods	Group III woods	Group IV woods
Sinker or cooler:			
7d	23	26	19
8 or 9d	19	21	16
10d	18	19	14
Corker:			
8 or 9d	17	19	14
10d	15	16	12
Common:			
7d	19	21	16
8 or 9d	15	17	13
10d	13	14	10

[1] Use one-half of total required for each side.
[2] Should have coated, etched, or deformed shanks.

For lumber sheathing, this requires twentypenny nails and predrilled nail holes to prevent splitting of the members. Holes ⅛ inch in diameter should be satisfactory. When ⅜-inch plywood sheathing is used, a twelvepenny nail is satisfactory. Space nails about 12 inches apart (fig. 13).

Fastening the sides and ends to each other in this manner results in a rigid crate corner, because no matter how the corner is stressed during handling and shipping, at least one set of nails will be in lateral resistance.

Fastening Top to Sides and Ends

The construction of the top panels of sheathed crates varies a great deal. Narrow crates do not require top joists to support top loads, since the sheathing alone has sufficient strength. In wider crates, however, joists are used to carry these loads. Because of these and other variations, such as joist support systems, the nailing procedure for fastening tops to sides and ends may be quite different. Whenever possible, however, nailing should be in two directions: from top to side and from side to top.

The nails for fastening the sides and ends to the top are driven through the sheathing into an edge or other frame member of the top. Use eightpenny or ninepenny nails for lumber sheathing and sevenpenny nails for plywood sheathing less than ½ inch thick. Space nails about 6 inches apart (fig. 13).

The top is fastened to the sides and ends with nails driven through the sheathing and edge members of the top, and into the upper frame members or joist spacers of the sides and ends. For top frame members 1 inch thick, twelvepenny nails are needed to get

at least 1½ inches of penetration into the side or end members. For ⅜- or ½-inch plywood sheathing, tenpenny nails are adequate. Space nails about 8 inches apart.

These assembly nailing methods may not be strictly applicable to all styles of sheathed crates, but the principles on which they are based apply fairly generally. In addition to assembly with nails and lag screws, many crates are strapped with a metal corner-reinforcing strap. This affords some additional measure of safety under the severe handling that may be encountered in export shipping. However, for domestic shipment, and for crates that have a large amount of two-way nailing, strapping is often unnecessary. Tension straps are sometimes used to fasten tops to sides and ends of special crates; for example, to permit removal of the top simply by cutting the straps.

Rules for Nailing Crates

1. Unless nails are clinched, use cement-coated, etched, or deformed-shank nails to gain increased withdrawal resistance. Nails used for assembling crates should have a diameter at least equal to that of the sinker nail (table 1).

2. In fabrication of panels for large sheathed crates, fasten adjacent frame members to each other with corrugated fasteners or staples before the sheathing is applied, unless jigs are used. This aids in the alinement of the various frame members.

3. Whenever possible, drive nails through the thinner into the thicker frame member. This is recommended especially when plywood is fastened to nominal 1- or 2-inch members.

4. When nailing two pieces of lumber together flatwise, as in panel fabrication, clinch the nails if the combined thickness is 3 inches or less. Use a ¼-inch clinch for nails up to sevenpenny in size, a ⅜-inch clinch for eightpenny through twelvepenny nails, and a ½-inch clinch for larger nails. Plywood ⅜ inch or less in thickness may be nailed to nominal 2-inch members without clinching if the nails penetrate 1½ inches into the members.

5. When the combined thickness of two pieces of lumber nailed together flatwise is more than 3 inches, or when the flat face of one member is nailed to the edge of another, nails are not clinched. Tenpenny and smaller nails should penetrate into the piece holding the nail point for a distance equal to about 2 to 2½ times the thickness of the piece holding the nailhead. Twelvepenny and larger nails should penetrate at least 1½ inches into the piece holding the point.

6. If diamond-point nails split the wood, blunt the points slightly with a hammer, clipper, or other convenient tool. If blunting does

not prevent splitting, use nails of the next smaller penny size and pace them a little closer together. Lead holes about three-fourths s large as the nail in diameter will also reduce splitting. Except or very large members, predrilling is usually used for twentypenny ails and larger.

7. In general, drive nails no closer to the edge of a piece than a listance equal to one-half the thickness of the piece and no closer o its end than the thickness of the piece. Smaller nails of a given ype can be driven closer to the edges or ends than larger ones ecause they are less likely to split the wood.

8. To minimize wood splits, either stagger the nails or place them n two or more rows.

9. When nailing two pieces of lumber together facewise and at ight angles to each other, use nailing patterns similar to those hown in figure 9. Use the patterns and recommended numbers of ails for fabrication of crate panels where nails are clinched when astening pieces of lumber together flatwise. Use also when nailing piece of lumber flatwise to the edge of another or to the face of larger frame member.

10. When attaching two members so that their grain is parallel, uch as sheathing to struts, the number of nail rows is usually deternined by the width of the surface in contact. Use one row, stagered when possible, for surface widths up to 2 inches, two rows for vidths from 2 inches through 4 inches, and three rows for widths reater than 4 inches.

11. When nailing plywood to struts or other members, space nails ot more than 4 inches on center and stagger them in rows spaced ot less than 3/4 inch apart. Space the rows as far apart as possible o increase the racking resistance of the joint.

12. When nailing a 1-inch-thick frame member flatwise to a -inch-thick member to form a laminated beam or similar member, se sevenpenny nails with the heads placed on the thinner member. Space nails about 16 inches apart in the rows. Use two rows for - and 6-inch pieces and three rows for wider pieces. Stagger the ails between rows. Longer nails may be used and then clinched. Place nails about 1 to 1 1/2 inches from the edges.

13. When nailing two members, each 2 inches thick, together flatvise, as when making laminated joists or beams, use twelvepenny ails placed 1 to 1 1/2 inches from the edges, according to the width, nd approximately 16 inches apart in the rows. Use two rows of ails for members 4 to 6 inches wide and three rows for wider nembers. Drive nails in each row alternately from opposite sides f the pieces. Stagger the nails between rows.

14. When three pieces of 2-inch lumber are to be nailed together, rst nail two of the pieces together with twelvepenny nails spaced

and located as described in rule 13, except that all nails are driven from the same side. Nail third piece to the piece that contains the nail points with twelvepenny nails spaced about midway between the points of the first nails.

15. In fabrication of sheathed crate panels, drive at least two nails through each sheathing board into each member it crosses. In assembly, also, use at least two nails to fasten each sheathing board to each framing member, including skids.

16. When two pieces of plywood sheathing are butt jointed, position the joints at the center of a vertical or horizontal frame member. Nail the abutting edge of each sheet of plywood with two rows of clinched nails, staggering the nails between rows.

RESISTANCE OF NAILS TO DIRECT AND LATERAL FORCES

During handling and shipping of boxes and crates, the nails used in their construction are subjected to direct-withdrawal and lateral forces. The ability of nails to resist these stresses depends not only on the species and condition of the wood but also on the kind and type of nail used (fig. 4).

Withdrawal resistance is the resistance of a nail to forces that tend to pull it from a piece of wood. Lateral resistance is the resistance of a nail to forces applied at right angles to its length. Lateral resistance depends principally on the diameter of the nail, the density of the wood, and the depth of penetration. A nail should penetrate wood to a distance at least 10 times its diameter in dense species and 14 times its diameter in species of moderate or low density.

Direct-withdrawal and lateral forces can be calculated. Later sections of this handbook give methods used to determine the resistance of nails under many conditions, and tables that list allowable loads for various constructions.

Factors Affecting Nail Resistance to Removal Forces

In calculating withdrawal resistance, the allowable load primarily depends on depth of nail penetration, the specific gravity of the wood, and the diameter of the nail. Other mechanical factors, however, also affect withdrawal resistance; among these are surface condition of the nail, type of nail point, type of nailhead, direction of driving, whether the nail is clinched or unclinched, moisture content of the wood when nailed and while in use, and amount of wood splitting.

Surface Condition of Nails

The surface condition of nails is sometimes modified during the manufacturing process to increase their withdrawal resistance. These modifications consist of surface coating, surface roughening, or surface deformation.

Surface-Coated Nails.—One of the most common surface treatments for nails used in the assembly of boxes and crates is cement coating. In many specifications, use of cement-coated nails is required where nails are not clinched. In low-density woods, cement coating adds materially to withdrawal resistance if it has been properly applied. In denser woods, much of the nail's coating may be removed while it is being driven into the wood. Cement-coated nails from different lots may vary greatly in withdrawal resistance according to the way in which they were processed. Different techniques for applying the coating, and variations in the ingredients used, cause large differences in the nail's resistance to withdrawal.

Under such conditions, cement-coated nails may have only a slight initial advantage over bright nails. The greater withdrawal resistance of cement-coated nails is not permanent; it may drop off within a few months.

Nails that have special coatings, such as zinc, are intended for use where corrosion is an important factor in performance or appearance. Over a period of time, uniformly galvanized nails have some advantage in withdrawal resistance over plain nails.

Roughened-Shank Nails.—The chemically etched nail has a roughened shank and is somewhat superior to a cement-coated nail because its finish does not deteriorate as does the cement coating. Under impact loads, however, the withdrawal resistance of an etched nail differs little from that of the plain or cement-coated nail.

Sandblasted nails perform much as do chemically etched nails, in that both types provide roughened surfaces that engage wood fibers and resist withdrawal.

Deformed-Shank Nails.—The majority of nails used in the construction of boxes and crates have smooth, cylindrical shanks. Any variation from this form is usually intended to increase the surface area without adding weight. Nails with barbed, spirally grooved, annular-grooved, and other types of deformed shanks are widely sold (fig. 4). In wood that does not change in moisture content the withdrawal resistance of these nails, except for some types of barbed nails, is somewhat greater than that of a common wire nail. Under changing moisture conditions, however, some of these nails have much greater withdrawal resistance than the common wire nail. In general, the annular-grooved nails sustain larger static-with-

drawal loads and the spirally grooved nails sustain greater impact-withdrawal loads than do other nail forms.

Some types of deformed-shank nails are more difficult to drive than the plain-shank nails. This is especially so in the denser species of wood and in species that have a marked difference between springwood and summerwood.

Nail Points

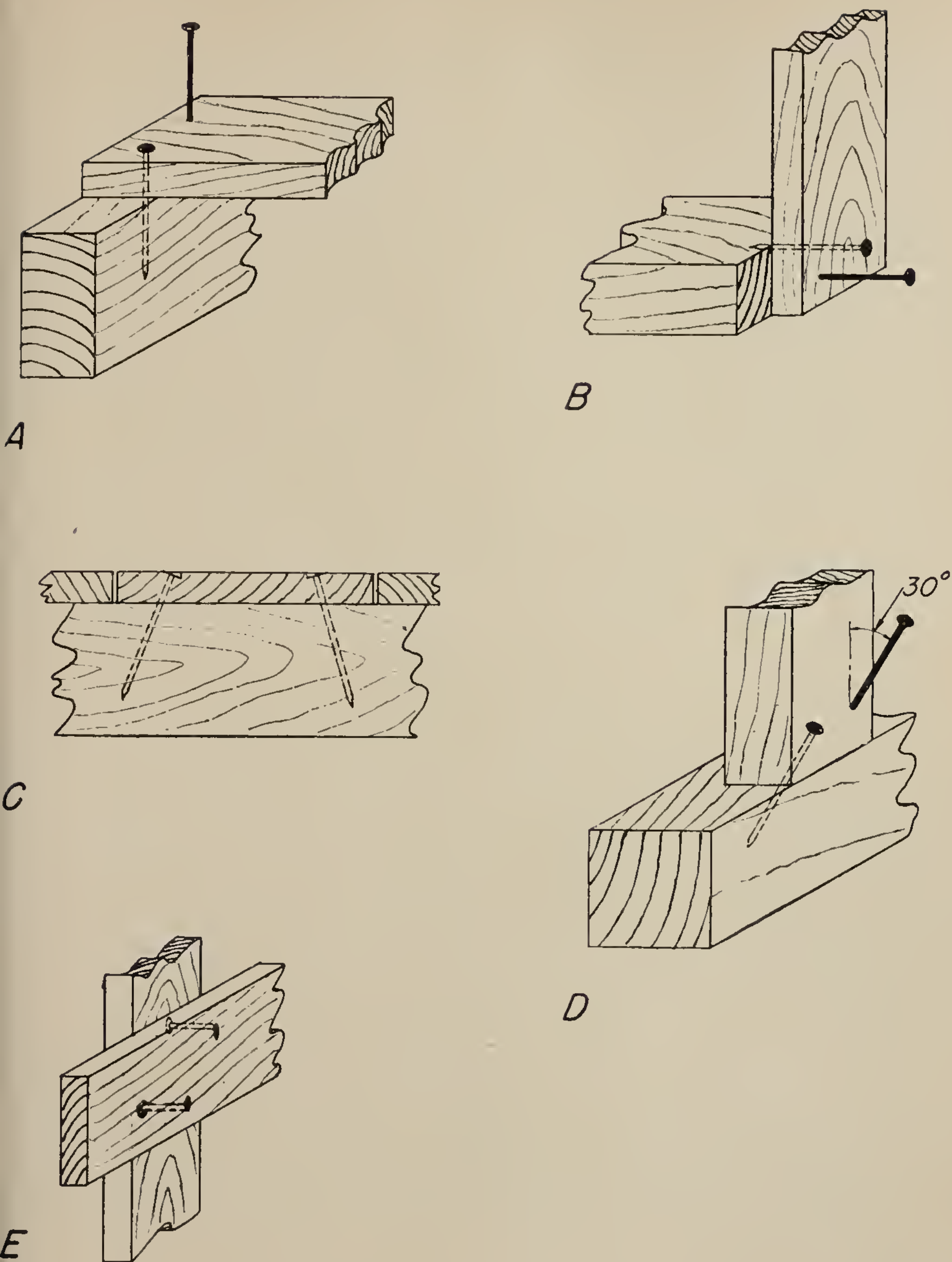
The shape of the nail point has some influence on withdrawal resistance. Nails with long, sharp, conical points will usually have higher withdrawal resistance than nails with diamond points, such as most common and cement-coated nails have (fig. 5). However, the sharp-pointed nail's tendency to split the denser species of wood lowers its withdrawal resistance. When such a point is blunted to form a truncated point, there is less splitting than with the common nail and, in the heavier woods, about the same withdrawal resistance. In the less dense woods, however, nails with truncated points have less resistance to withdrawal than diamond-pointed nails. Nails with blunt or flat, untapered points do not split wood so easily. They tear the wood fibers much more, however, and therefore have lower withdrawal resistance than common wire nails.

Nailheads

Nailheads prevent the pieces holding them from pulling loose when a force is applied. Nailheads vary in size and shape, but most nails commonly used in box and crate construction have a round, flat head. The sinker nail has a head with reinforcing fillet underneath, and this is called a countersunk head (fig. 5). The countersunk nailhead is strong enough to withstand the force required to withdraw the nail from most species of woods. Nails with thin, flat heads should not be used in the denser woods, because the nailhead may be broken off or damaged when the nail is driven, or when stresses are applied. When nailheads are damaged, the strength of the joint is greatly reduced.

Direction of Driving

The resistance of nails to withdrawal is greatest when they are driven perpendicular to the grain of the wood, as in side-grain nailing (fig. 14). When they are driven parallel to the wood fibers, as into the ends of a piece, their holding power may drop to as low as 50 percent of the side-grain values. Slant driving has some advantages over straight driving when nails are driven into the end grain of the wood.



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'IGURE 14.—Methods of nailing: *A*, Through side grain of both pieces; *B*, through side grain into end grain; *C*, slant-driven nails; *D*, toenailing; *E*, clinched nails.

Toenailing, often used in the framing of large structures, consists
f driving the nails at an angle through the end or edge of one
nember into another member (fig. 14). The best results with this
ype of nailing are obtained when (1) the largest nail that will not
plit the wood excessively is used, (2) the distance from the end
f the member to the point where the nail enters it is at least one-
hird the length of the nail, (3) the nail is driven at an angle of

30 degrees to the face of the piece it enters first, and (4) the head of the nail is buried without excessively mutilating the wood. Toenailing requires greater skill but provides greater strength than end-grain nailing.

Clinched Nails

Because their pointed ends are bent against the wood (fig. 14), clinched nails normally have much higher withdrawal resistance than unclinched nails. However, this advantage varies a great deal with the size of the nail, the moisture content of the wood, and other factors. This increase in withdrawal resistance can vary from 50 to almost 450 percent. Nails clinched across the grain of the board have approximately 20 percent more resistance to withdrawal than nails clinched parallel to the grain. In box and crate construction, clinched nails are ordinarily used in fabrication of panels or other container parts, and unclinched nails are used to assemble the panels.

Overdriving

Overdriving of nails occurs most often in machine nailing boxes. It may be caused by variations in sheathing thickness, by differences in the density or species of the boards, or by improper setting of the machine. Overdriving is undesirable in fabrication nailing of container panels and may be seriously detrimental in assembly of parts. It reduces the amount of wood under the nailhead and consequently decreases the withdrawal resistance, especially when thin sheathing is used.

Prebored Lead Holes

To prevent splitting of the wood, it is often necessary to drill lead holes for the larger nails, especially in dense woods. Nails driven into lead holes, which are usually about three-fourths the diameter of the nail, have slightly higher withdrawal resistance than nails driven without lead holes.

Nails in Plywood

One advantage of plywood is its greater resistance to splitting, so that nails can be placed close to the edges. The nail-withdrawal resistance of plywood is from 15 to 30 percent less than that of solid wood of the same species and thickness. However, for plywood less than ½ inch thick, the high splitting resistance tends to offset the lower withdrawal resistance as compared with solid wood.

Placement of Nails

Figure 15 illustrates improper and proper placement of nails along he edges of end sheathing or end cleats. The nails in *A* and *B* are orced outward because of severe grain divergence. Improper slop-ng of the nail is shown in *C*, and *D* shows the result of too close dge and end spacing. In *E*, the nail was placed so far in from he end that it missed the cleat. So placed it may damage the ontents. In *F*, the nail is shown properly placed with respect to he thickness of the cleat, but contact with a knot has bent it out-ard, causing a "shiner." What happens when corner nails come n contact with each other is shown in *G*. Finally, *H* shows a prop-rly placed and driven nail.

Diameter of Nails

Nail diameter has much to do with both lateral resistance and irect withdrawal resistance. The greater the diameter, however, ne greater the likelihood that the wood will split. This is especially ue of dense species when the moisture content of the wood is low.

Depth of Nail Penetration

The depth to which a nail penetrates is directly related to its ithdrawal resistance because the deeper the penetration, the greater ne contact with wood fibers. Withdrawal resistance is calculated n the basis of the depth of penetration in inches. In lateral re-stance, a minimum penetration is required and no premium is lowed for greater penetration. However, in actual handling of ates and boxes, the same nail is often subjected to both lateral nd withdrawal stresses; hence good penetration has advantages.

Species and Density of Wood

Species and density of wood definitely influence the withdrawal sistance of nails, and the two are generally related. In with-awal tests [2] at the Forest Products Laboratory, it was found that ithdrawal resistance was more than doubled when the density of e wood tested was twice as high. For example, for an average ensity of 0.33, the average withdrawal resistance of a cement-ated nail was 150 pounds, as compared with 440 pounds for an erage density of 0.66. These tests were made on wood that had moisture content of about 10 percent or less. The nail was with-awn immediately after it was driven.

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[2] U.S. Forest Products Laboratory. NAIL-HOLDING POWER OF AMERICAN ODS. Tech. Note 236. 1958.

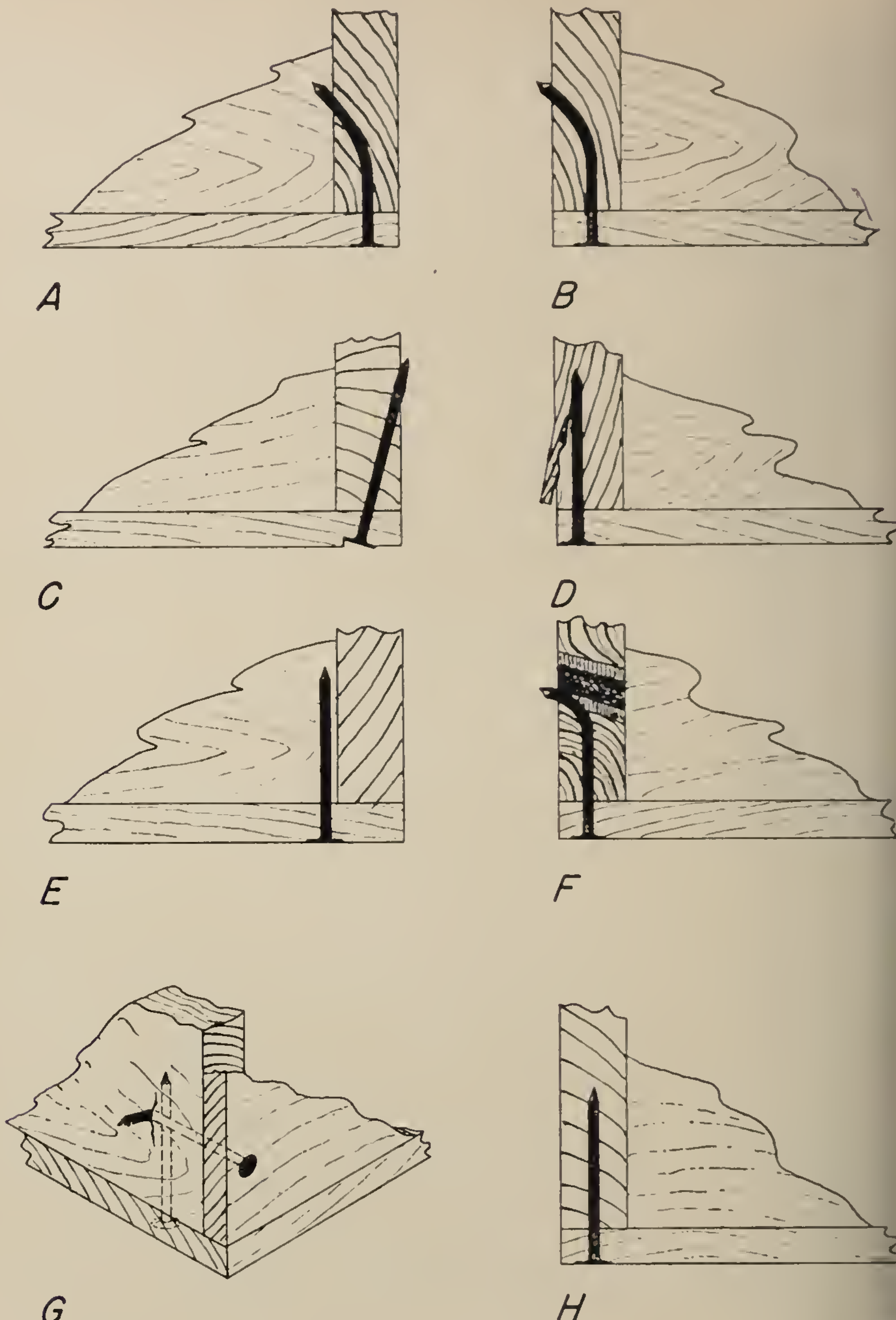

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FIGURE 15.—Improper and proper nailing: *A* and *B*, Nail bent by divergent grain; *C*, slanted nail; *D*, nail too close to edge; *E*, too great end spacing; *F*, nail bent by contact with knot; *G*, nail bent by contact with another nail; *H*, nail properly placed and driven.

Moisture Content of Wood

The moisture content of wood has a definite effect on the with-lrawal resistance of nails, on ease of driving, and on the wood's endency to split. Changes in moisture content have an even greater effect on withdrawal resistance. As green lumber dries, the with-lrawal resistance of nails falls off. A nail driven into and immedi-tely pulled from green wood has almost 4 times the withdrawal esistance it would have if it were left there 1 year while the wood lried and was then pulled.

It is good practice to use wood that has a moisture content of ess than 19 percent for building containers. However, wood with n extremely low moisture content is not desirable for containers, ince subsequent moisture pickup and loss will also reduce with-lrawal resistance of nails and may cause the lumber to warp and plit.

How To Determine Nail Resistance

The two main calculable functions of nails used for assembly in ox and crate construction are their resistance to direct withdrawal nd their resistance to lateral stresses. In rough-handling tests of

TABLE 7.—*Average allowable loads*[1] *for nails in direct withdrawals*[2] (*nails equal in diameter and length to sinker nails*)

Wood species	Allowable load					
	Six-penny	Eight-penny	Ten-penny	Twelve-penny	Sixteen-penny	Twenty-penny
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Basswood, cottonwood, true firs, pines (except southern yellow), spruces, yellow-poplar, and similar species	18	27	35	42	49	58
Western hemlock, red pine, redwood, other species of similar density	25	37	48	58	66	79
Soft elm, sweetgum, black ash, soft maple, other species of similar density	34	51	66	81	93	111
Douglas-fir, western larch, southern yellow pine, other species of similar density	38	56	73	89	102	121
White ash, beech, birch, hard maple, oaks, rock elm, other species of similar density	59	88	114	140	159	190

[1] Based on normal conditions for containers.
[2] When driven into side grain of seasoned lumber to a depth equal to two-thirds of its length.

wood boxes, both types of failures have been noted. In drop tests made with crates, the nail failures noted in the joints between sides and base were caused primarily by lateral forces.

Formulas have been developed [3] to determine the allowable loads for direct withdrawal resistance and lateral resistance of nails. These formulas have been based on nails used for construction, as for nailing of wood trusses, and for fabrication and assembly of other structural units. They are applicable under conditions of long-continued or permanent loading; however, they can be modified for loads of short duration or where the loading conditions are not so severe. Thus, the formulas in the text and the allowable load values for containers given in tables 7 and 8 have been increased about 20 percent above those for permanent loading. They are considered satisfactory for loading and storage conditions to which boxes and crates are normally subjected. Under extreme shipping, storage, or handling conditions, however, allowable loads may be reduced from those included in tables 7 and 8. Only side-grain nailing is considered in the calculations that follow.

TABLE 8.—*Average allowable loads* [1] *for nails in lateral resistance* [2] *(nails having diameters equal to sinker nails)*

Wood species	Allowable load					
	Six-penny	Eight-penny	Ten-penny	Twelve-penny	Sixteen-penny	Twenty-penny
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Basswood, cottonwood, true firs, pines (except southern yellow), spruce, yellow-poplar, other species of similar density	30	41	45	54	62	81
Western hemlock, red pine, redwood, other species of similar density	37	51	57	67	77	101
Soft elm, sweetgum, black ash, soft maple, other species of similar density	42	57	63	75	86	112
Douglas-fir, western larch, southern yellow pine, other species of similar density	46	63	69	82	94	123
White ash, beech, birch, hard maple, oaks, rock elm, other species of similar density	56	78	85	101	117	152

[1] Based on normal storage and handling conditions.

[2] When driven in side grain of seasoned lumber, minimum distance of penetration equal to two-thirds of its length in the softer woods and one-half in the denser woods.

[3] U.S. FOREST PRODUCTS LABORATORY. WOOD HANDBOOK. U.S. Dept. Agr., Agr. Handb. 72, 528 pp., illus. 1955.

Direct-Withdrawal Resistance

The resistance of nails with circular, uncoated, plain shanks to direct withdrawal depends on the specific gravity of the wood, the nail diameter, and the depth of penetration. The following formula may be used to determine the allowable direct-withdrawal load for nails of any size under normal conditions of use typical of containers:

$$P = 1{,}380\, G^{\frac{5}{2}} D$$

where P is the allowable load in pounds per inch of penetration into the member receiving the point (side grain of seasoned wood), G is the specific gravity of species of wood, based on weight and volume when ovendry,[4] and D is the diameter of the nail in inches.

Table 9 lists the specific gravity, G, and $G^{\frac{5}{2}}$ for a number of woods commonly used for the construction of boxes and crates.

Table 10 lists nail diameters and other data used in the formulas for determining withdrawal values as well as for calculating the lateral resistance of nails. If nails other than bright, common

TABLE 9.—*Values for specific gravity* (G) *of ovendry wood used in calculating direct-withdrawal loads for nails*

G	$G^{\frac{5}{2}}$	G	$G^{\frac{5}{2}}$	G	$G^{\frac{5}{2}}$
0. 32	0. 06	0. 47	0. 15	0. 62	0. 31
. 35	. 07	. 50	. 18	. 65	. 34
. 38	. 09	. 53	. 20	. 68	. 38
. 41	. 11	. 56	. 23	. 71	. 42
. 44	. 13	. 59	. 27	. 74	. 47

TABLE 10.—*Sizes of bright common wire nails*

Size (penny)	Gage	Length	Diameter	
			D	$D^{\frac{3}{2}}$
		Inch	*Inch*	*Inch*
4	12½	1½	0. 098	0. 0307
6	11½	2	. 113	. 0380
7	11½	2¼	. 113	. 0380
8	10¼	2½	. 131	. 0474
9	10¼	2¾	. 131	. 0474
10	9	3	. 148	. 0570
12	9	3¼	. 148	. 0570
16	8	3½	. 162	. 0652

[4] MARKWARDT, L. J., and WILSON, T. R. C. STRENGTH AND RELATED PROPERTIES OF WOODS GROWN IN THE UNITED STATES. U.S. Dept. Agr. Tech. Bul. 479, 99 pp., illus. 1935.

wire nails are used (such as sinker nails), the gage, length, and other values will change from those in the table.

The sinker nail is the type most often used in the assembly of boxes and crates. Table 7 lists the average allowable loads for direct withdrawal of sinker nails, or nails of equal diameter and penetration, in box and crate construction. These are average values, however, and values for individual species or pieces may be somewhat higher or lower than those listed in the table. The values in table 7 do not allow for any shank treatment, shank roughening, or deformation.

Lateral Resistance

Lateral resistance is the resistance of the nail to lateral loads applied at right angles to the length of the nail. For example, this is the type of force to which nails used to fasten ends and sides of a crate are subjected. As in the method used for determining the allowable direct-withdrawal values, the specific gravity of wood and the diameter of the nail must be considered in calculating allowable loads. The formulas are based on the penetration of an uncoated, circular-shank nail into wood. The nail should penetrate into the lower density species a distance of about two-thirds its length. In the higher density species, nails should penetrate to a distance about one-half their length.

The following formulas can be used for determining the allowable lateral resistance of nails driven into the side grain of various species of wood. The values are based on stresses normally placed on containers.

Species	*Formula*
Basswood, cottonwood, true firs, pines (except southern yellow), spruces, yellow-poplar, other species of similar density	$P=1{,}080\ D^{\frac{3}{2}}$
Western hemlock, red pine, redwood, other species of similar density	$P=1{,}350\ D^{\frac{3}{2}}$
Soft elm, sweetgum, black ash, soft maple, other species of similar density	$P=1{,}500\ D^{\frac{3}{2}}$
Douglas-fir, western larch, southern yellow pine, other species of similar density	$P=1{,}650\ D^{\frac{3}{2}}$
White ash, beech, birch, hard maple, oaks, rock elm, other species of similar density	$P=2{,}040\ D^{\frac{3}{2}}$

In these formulas, P is the allowable load per nail in pounds and D is the diameter of the nail in inches.

The values for $D^{\frac{3}{2}}$ are given in table 10 for various sizes of nails.

Table 8 is included for the convenience of builders of boxes and crates, and formulas need not be used except for special conditions. The values are based on the sinker nail or other nails of equal diameter.

Wood Groups

Many species of wood are adaptable for use in the construction of boxes and crates. The various species commonly used are divided into four groups, largely on the basis of their density. Other factors on which the groupings are based include their nail-holding power, ease of working, and their splitting tendency. It is always good practice, in the construction of containers, to use species in the same group for similar parts. For example, the sheathing of a crate should consist of species in one group. The cleats of a nailed wood box should also be selected from one group, although not necessarily the same one. By doing so, the builder can use a single set of umber sizes and nailing practices. Most container specifications lesignate the size of members and the size and spacing of nails ccording to wood groups. The denser woods are used in smaller izes and fastened with fewer nails.

In the following groups are listed the various species of woods ommonly used for the construction of containers:

GROUP I includes the softer woods of both the coniferous (soft-vood) and broad-leaved (hardwood) species. These woods do not plit readily when nailed, have moderate nail-holding power, mod-rate strength as a beam, and moderate shock-resisting capacity. 'hey are soft, lightweight, and easy to work, hold their shape well fter manufacture, and usually are easy to dry.

Aspen (popple)
Basswood
Buckeye
Cedars
Chestnut
Cottonwood
Cypress
Firs (true)
Magnolia
Pine (except southern yellow)
Redwood
Spruces
Willow
Yellow-poplar

GROUP II consists of the heavier coniferous woods. No hard-ood species are included. These woods usually exhibit a pro-ounced contrast in the hardness of the springwood and the ımmerwood. They have greater nail-holding power than the roup I woods, but they tend to split more readily. The hard ımmerwood bands often deflect the nails and cause them to pro-ude from the side of the piece.

Douglas-fir
Hemlock
Southern yellow pine
Tamarack
Western larch

GROUP III consists of hardwoods of medium density. No niferous species are included. These woods have about the same il-holding power and strength as a beam as the group II woods,

but are less inclined to split and shatter under impacts. Group III species are the most useful woods for box ends and cleats. This group includes those woods from which most of the rotary-cut lumber for wirebound and plywood boxes is obtained.

Ash (except white)	Sweetgum
Soft elm	Sycamore
Soft maple	Tupelo

GROUP IV woods are the heavy hardwood species. They have both the greatest shock-resisting capacity and the greatest nail-holding power. Because of their extreme hardness it is difficult to drive nails into them and they have the greatest tendency to split. They are the heaviest and hardest domestic woods and are difficult to work. They are especially useful where high nail-holding power is required. Many of them make excellent rotary-cut lumber for wirebound and plywood boxes.

Beech	Oaks
Birch	Pecan
Hackberry	Rock elm
Hickory	White ash
Hard maple	

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BOUND SEPARATELY

Managing Grass-Shrub Cattle Ranges in the Southwest

By Hudson G. Reynolds

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CONTENTS

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Managing Grass-Shrub Cattle Ranges in the Southwest

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INTRODUCTION

Grass-shrub rangelands occupy extensive acreages in southeastern rizona and southwestern New Mexico between elevations of 3,000 nd 5,000 feet. At lower elevations, the grass-shrub type merges vith deserts dominated by creosotebush.[2] At higher elevations, the ype forms a transition with chaparral, pinyon-juniper, or oak-voodland types (fig. 1). Perennial grasses are the mainstay of the orage supply but browse species and annual grasses are sometimes mportant.

Sustained high production of perennial grass forage depends upon tocking the proper number of animals, grazing at appropriate times, nd providing for optimum distribution of livestock. The usual ractice is to graze the ranges yearlong. Annual or periodic ad-ustments in number of grazing animals are necessary because of vide variations in forage production. Seasonal adjustments are also elpful. Grazing can often be planned to make summer use of bundant annuals at lower elevations, spring use of ranges where rowse is abundant, and winter use of ranges where black grama an important component.

Better utilization of grass-shrub ranges can be had by fencing ıbdivisions to accomodate 50 to 100 animal units, providing ermanent and dependable watering places, and using salt or salt-eal mix judiciously. On many ranges forage production is low ecause undesirable shrubs have replaced good forage species. Here, ırub control, revegetation, or other measures are needed to restore orage production.

This publication describes the grass-shrub type at Santa Rita xperimental Range, about 30 miles south of Tucson, Ariz. Recom-endations for management of the type and improvement in prac-ces are based upon intensive work on the experimental range and oservations elsewhere. Many of the recommendations are applicable, ossibly with local modifications, over the entire grass-shrub range.

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[1] Central headquarters of station maintained at Fort Collins, Colo., in cooper-ion with Colorado State University; studies reported in this publication were nducted in cooperation with the University of Arizona, Tucson, Ariz.

[2] Common and scientific names of plants mentioned are listed on page 38.

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FIGURE 1.—Grass-shrub rangelands (*B*) lie between the oak-woodland and chaparral areas (*A*) above 5,000-foot elevation, and the creosotebush desert (*C*) below 3,000 feet.

THE EXPERIMENTAL RANGE

Santa Rita Experimental Range is an area of about 52,000 acres. t is on a gently sloping plain that drains northwest into Santa Cruz River. The general topography is interrupted by a few stony uttes and low foothills, and by numerous drainage channels.

Twenty experimental pastures constitute the experimental range. razing studies are conducted with privately owned cattle, but graz-ng management plans are under control of the Federal Government. Vells, surface tanks, and pipelines from mountain springs have been onstructed as opportunity and finances permitted.

Climate

At the experimental range headquarters at an elevation of 5,000 eet, daily maximum temperatures sometimes exceed 100° F. during ne summer. Mean minimum July temperature is 68° and the mean aximum in June is 91° (fig. 2). Frost-free periods extend from Iarch to November. More than 275 days are relatively cloudless ach year, with sunshine more than 80 percent of the time. Relative umidities are low, and wind movements are usually light and varia-le. Evaporation rate is about 75 inches a year from free-water rfaces.

Rainfall Distribution

Precipitation is almost entirely rain. About half of the annual infall comes during July, August, and September (fig. 2), and out 40 percent of it comes during the 6-month period October rough March. April, May, and June are the driest months of the ear. Typically, the rainfall pattern consists of a summer peak, winter plateau, and a late spring drought. About once in 10 years infall is unusually high in the winter or spring.

Summer and winter precipitation differ in origin of moisture and pe of storm. The torrential showers in the summer come from oisture-bearing air that originates over the Gulf of Mexico to the utheast. Winter storms—usually in the form of rain—are largely the frontal type, originating in the north and west.

Rainfall Variations

Annual and seasonal rainfall vary greatly (fig. 3). Over a period 50 years at Santa Rita Experimental Range headquarters, annual infall has varied from a maximum of 36.8 inches in 1930–31 to minimum of 11.2 inches in 1903–04, and has averaged 19.5 inches. Successive years of above-average or below-average rainfall are mmon. For example, in the 50-year record there are six periods which two successive years of below-average moisture occurred fore relief by a year of above-average rainfall; and in two other riods, three successive years of below-average rainfall occurred. Annual rainfall varies greatly with elevation. For example, on e southern edge of the experimental range, with a 500-foot increase elevation there is an average increase of 4 inches.

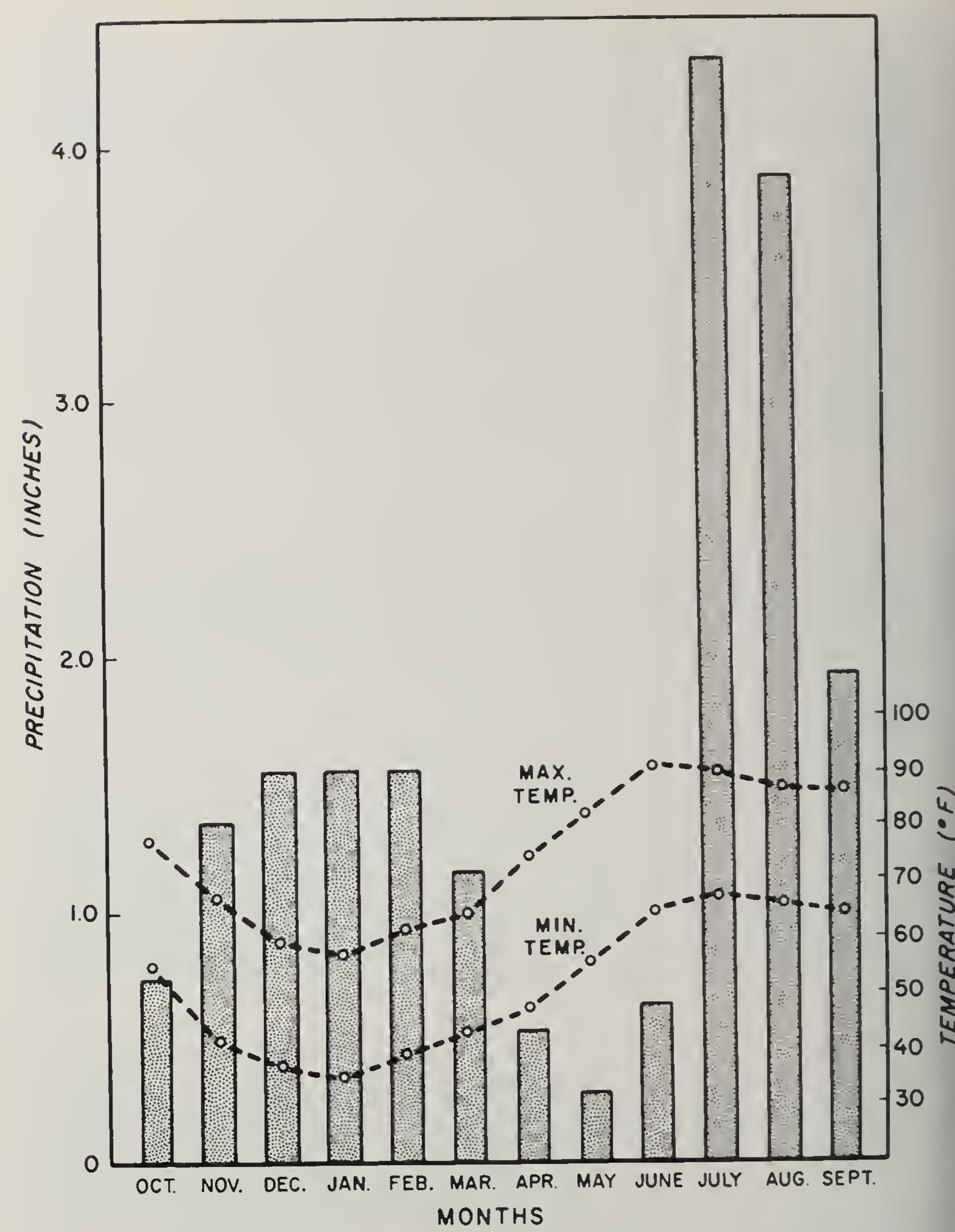

FIGURE 2.—Average monthly precipitation and average maximum and minimum monthly temperatures at Santa Rita Experimental Range, based on 50 years of record.

Summer rainfall is spotty. In a given year, differences of 1 inch have been noted within the distance of a mile, though the average rainfall at both locations is the same. One area may be drought stricken while an adjacent area may receive above-average rainfall. Also, individual storms may be extremely local; rains of 1 inch or more may fall on an area of less than a square mile.

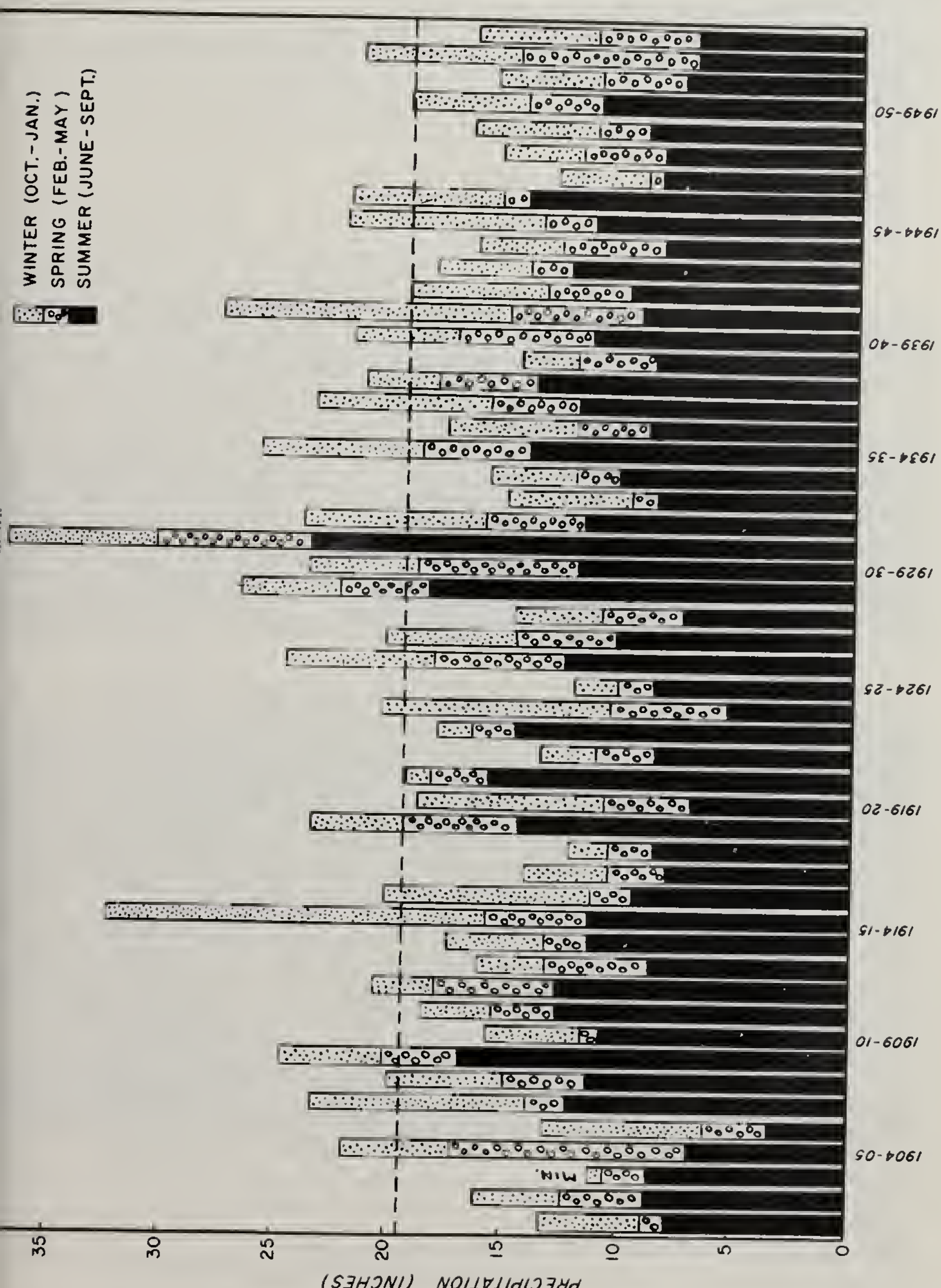

FIGURE 3.—Annual and seasonal precipitation at Santa Rita Experimental Range.

Vegetation

Because vegetation of the grass-shrub type varies with elevation, the vegetation on the experimental range will be discussed separately for lowest and driest elevations, upper and more moist elevations, and intermediate elevations. The range was considered to be in fair condition when surveyed in 1941. A list of the principal perennial grass and shrub species representative of each elevation and in order of abundance is given in table 1.

TABLE 1.—*Relative abundance of perennial grasses and shrubs for three elevations on Santa Rita Experimental Range for areas judged to be in fair condition* [1]

PERENNIAL GRASSES

High elevation (5,000–4,000 ft.; rainfall 19–16 in.)	Percent	Intermediate elevation (4,000–3,300 ft.; rainfall 15–13 in.)	Percent	Low elevation (3,300 ft. or less; rainfall 12 in. or less)	Percent
Sprucetop grama	38	Rothrock grama	7	Fluffgrass	2
Black grama	13	Black grama	5	Bush muhly	1
Arizona cottontop	7	Sideoats grama	3	Santa Rita threeawn	1
Slender grama	7	Curlymesquite	3	Rothrock grama	1
Sideoats grama	3	Bush muhly	2	Arizona cottontop	1
Threeawns, misc	3	Santa Rita threeawn	1	Sand dropseed	[2]
Hairy grama	2	Hairy grama	1	Threeawns, misc	[2]
Other perennial grasses	4	Arizona cottontop	1	Alkali sacaton	[2]
		Sprucetop grama	1	Tanglehead	[2]
		Plains bristlegrass	1	Black grama	[2]
		Sand dropseed	1	Other perennial grasses	[2]
		Threeawns, misc	1		
		Other perennial grasses	1		

SHRUBS

High elevation	Percent	Intermediate elevation	Percent	Low elevation	Percent
Velvet mesquite	9	Burroweed	35	Burroweed	46
Wright eriogonum	7	Velvet mesquite	20	Velvet mesquite	18
Falsemesquite	7	Cholla, cane & jumping	13	Cholla	15
		Shortleaf baccharis	2	Creosotebush	8
		Hackberry, spiny	2	Shortleaf baccharis	2
				Ephedra, longleaf	2
				Desert zinnia	2
				Saltbush, fourwing	1

[1] Approximate composition based upon areal cover by ocular estimate.
[2] Less than 0.5 percent.

At the highest elevations, perennial grasses make up three-fourths of the plant composition (fig. 4). Shrubs are sparse but some, such as falsemesquite and Wright eriogonum, are good browse. Important perennial grasses are the gramas—sprucetop, black, slender, sideoats, and hairy—Arizona cottontop, and threeawns. Miscellaneous grasses of lesser importance are Rothrock grama, plains lovegrass, green sprangletop, and curlymesquite.

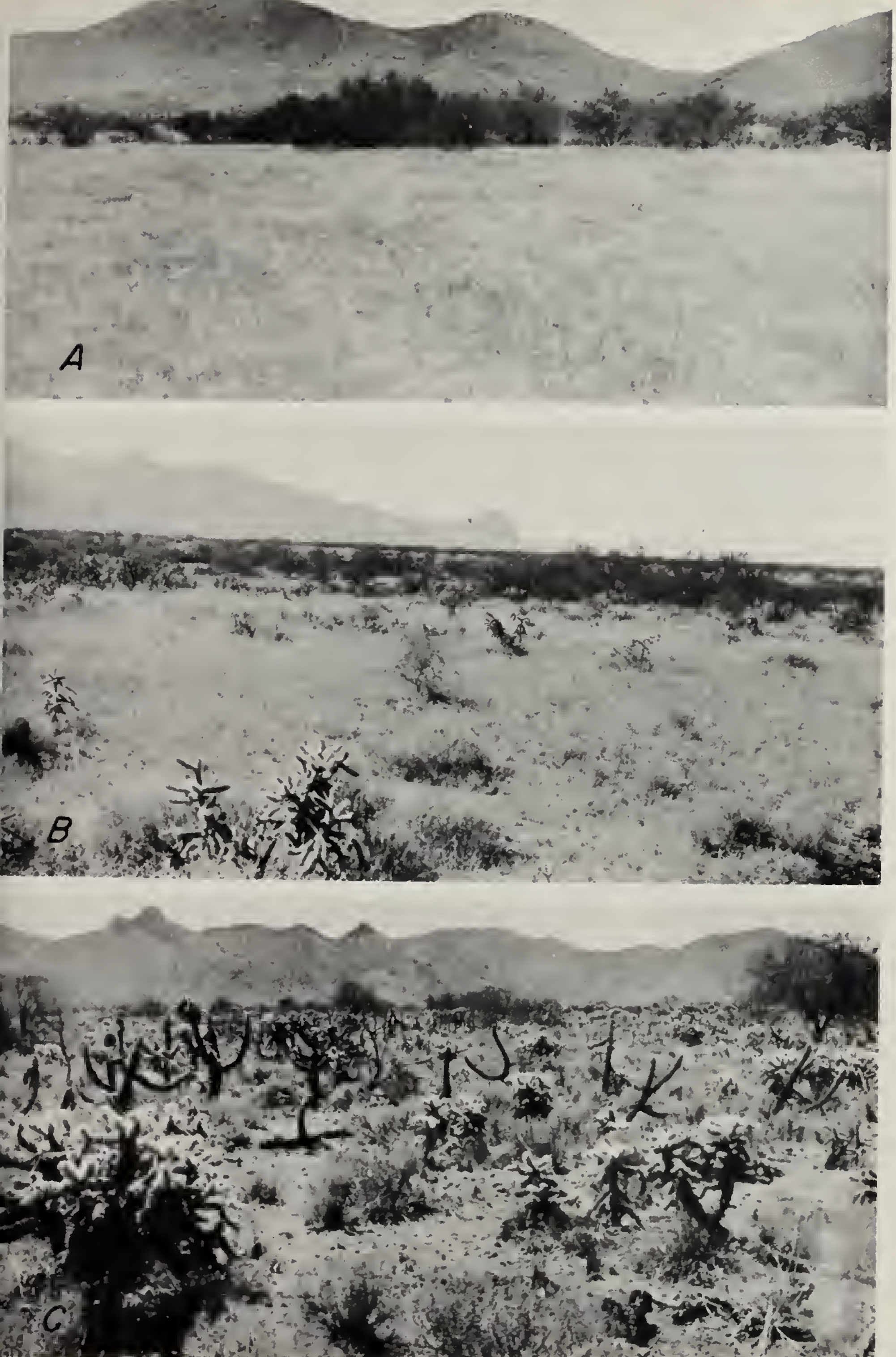

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FIGURE 4.—*A*, The highest elevations are characterized by perennial grass. Shrubs are confined largely to arroyos. *B*, At the intermediate elevations, shrubs are more abundant, and perennial grass density is lower. *C*, At the lowest elevations, shrubs and cacti predominate.

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Shrubby species comprise about 70 percent of the vegetation at the intermediate elevations. Low-value shrubs, such as burroweed, cholla, and velvet mesquite, are common. The natural habitat of these species is at the lower elevations. Woody plants have spread from there to many higher adjacent areas, making dense, vigorous stands of brush.

Perennial grasses are abundant at the intermediate elevations. Rothrock grama is most prevalent. It is fairly short-lived and fluctuates excessively with variations in rainfall. Among the more abundant grasses are black grama, sideoats grama, curlymesquite, and bush muhly. Other species found sparingly include Santa Rita threeawn, hairy grama, sprucetop grama, Arizona cottontop, and plains bristlegrass. Bush muhly and sand dropseed are prominent along the broad sandy washes.

Annual species, at times, constitute a large part of the vegetation at the intermediate elevations. Most common are annual herbs such as heronbill, Indianwheat, and deervetch; and such annual grasses as sixweeks threeawn, needle grama, and feather fingergrass.

Shrubs are dominant on the range at the lower elevations, and annuals and scattered clumps of perennial grass grow between them. The main woody species are burroweed, velvet mesquite, and cholla. Also present are such shrubs are creosotebush, desert zinnia, longleaf ephedra, fourwing saltbush, and shortleaf baccharis. Perennial grasses, mainly bush muhly, Rothrock grama, Arizona cottontop, and sand dropseed, are sparse. Fluffgrass is the most abundant species. Annual grasses outproduce perennial grasses during years of favorable rainfall.

The Forage Crop

Growth Periods

Rainfall during both summer and winter makes possible two growth periods—one during early spring when temperatures become favorable, and one during summer when rains begin after the late spring drought. Perennial grasses, browse, and annuals react in their own characteristic fashion to this climate.

Most perennial grasses begin growth with the start of summer rains and continue growing throughout July, August, and September. Some may also produce a little growth at intermittent intervals from February through June. However, more than 90 percent of perennial-grass growth is produced after summer rains begin (*9*)[3].

Height measurements of flower stalks of Rothrock grama, slender grama, and Arizona cottontop illustrate the growth response of perennial grasses to summer rainfall (fig. 5). During the year of measurement, the first rains came on June 28 after a 2-month dry period. Subsequent distribution of rainfall was excellent, and as a result growth was uninterrupted. Growth commenced about 2 weeks after the first rains, was most rapid during August, and was completed by September 22.

[3] Italic numbers in parentheses refer to Literature Cited, p. 39.

During the years 1929–33, length of growing season of perennial grasses measured at several sites varied from 56 to 84 days. The earliest date of growth was July 1, and the latest date was September 29. For the 5 years, average starting and ending dates were July 7 and September 14, for an average growing season of 69 days. On the average, growth commenced 11 days after the first effective rain and continued for 4 days after the last effective rain. An effective rain was defined as a total of at least 0.4 inch of rainfall on successive days.

Shrubby plants commence growth on winter-spring moisture. Growth usually begins in March and many species flower and fruit

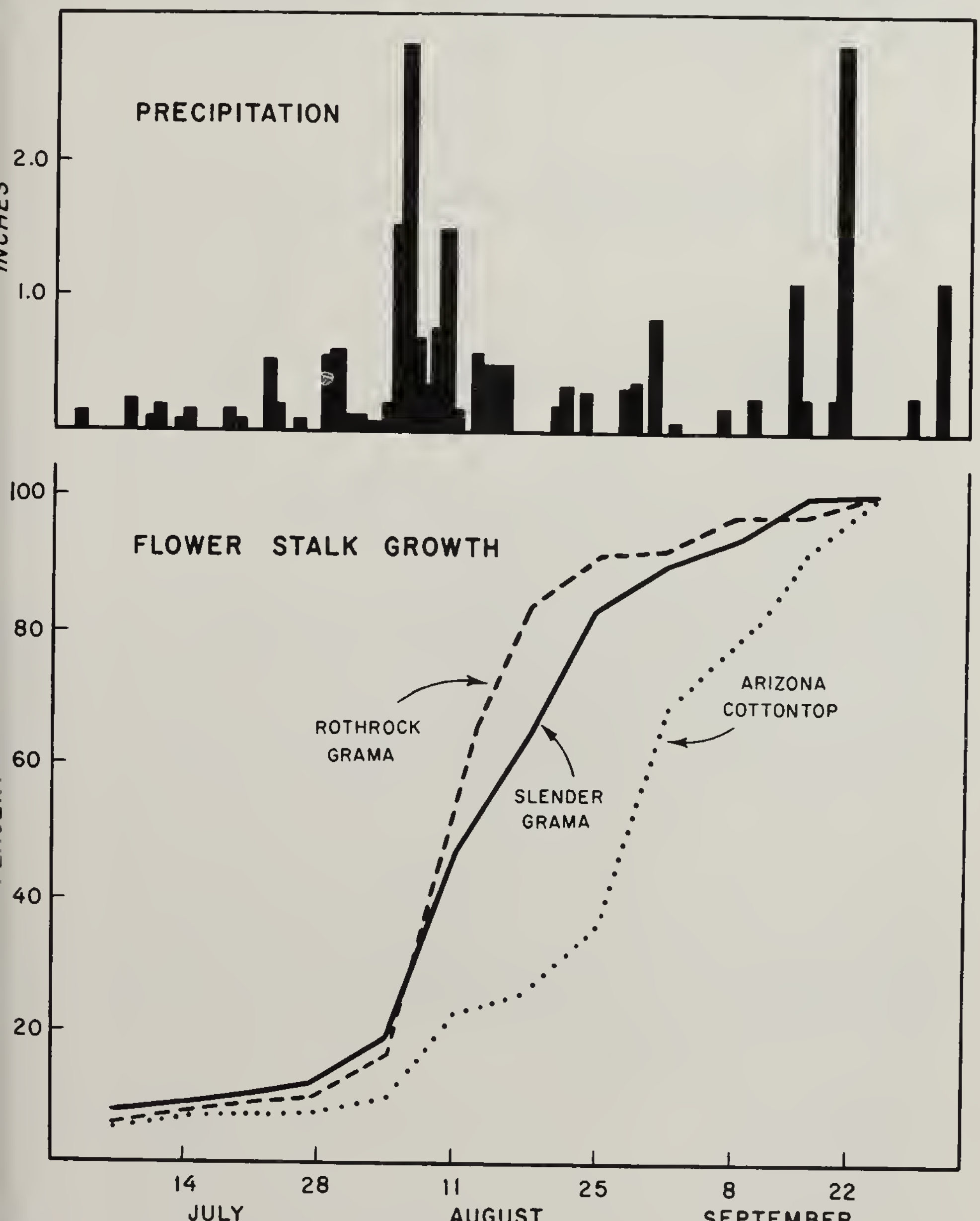

FIGURE 5.—Growth curves of flower stalks of slender grama, Rothrock grama, and Arizona cottontop in relation to rainfall distribution during one summer on Santa Rita Experimental Range.

in May. Some species flower and fruit a second time during the summer rainy season and complete the cycle in August or September. Leaves usually remain throughout the spring and summer growing season. However, some species, notably falsemesquite, may produce a second set of leaves during the summer rainy season if the May-June dry season is severe enough to cause defoliation.

Annual plants grow during two seasons. One group germinates at low temperatures and completes growth during the spring. Another group requires higher temperatures accompanied by summer rains. Examples of the low-temperature group are sixweeks fescue, heronbill, deervetch, and Indianwheat. Sixweeks threeawn, feather fingergrass, and needle grama are good examples of summer annuals.

Forage Production

Production of perennial grasses increases with elevation. The average production of perennial grasses on Santa Rita Experimental Range during the period 1939–49 was as follows:

Elevation (feet):	*Average annual rainfall (inches)*	*Perennial grass per acre (air-dry lbs.)*
5,000–4,000	16–19	440
4,000–3,300	13–15	260
3,300 or less	12 or less	110

On the average, the highest elevations produce about four times as much perennial grass herbage as the lowest. This difference occurs within a distance of less than 10 miles and within an elevation change of less than 2,000 feet.

Because of the cumulative effect of successive years of abnormal rainfall, production of perennial grasses varies more than rainfall. A year of low rainfall after several successive years of above-average rainfall does not affect production as greatly as if it followed several low rainfall years. Also, after a prolonged drought, increased rainfall does not produce an immediate response (*17*).

Production of annuals varies from year to year, depending on amount and distribution of rainfall. Production is abundant in years of favorable rainfall, but during dry periods seeds may not germinate. Large amounts of spring annuals are produced only during the infrequent wet winters. Production of summer annuals is more consistent but may differ greatly in some years.

The variation in annual grass production per acre is illustrated by the following tabulation:

Elevation (feet):	*1954 (pounds)*	*1955 (pounds)*	*1956 (pounds)*
5,000–4,000	130	360	80
4,000–3, 300	180	170	20
3,300 or less	450	220	10

This tabulation also shows the greatest variation at the low elevation, which receives the lowest average rainfall.

Forage Preferences

Cattle prefer green forage. As a result, grazing tends to be concentrated on areas where plants green-up early or remain green longer than usual.

Cattle often graze heavily on annuals that are in the growth stage. During favorable springs, heronbill, sixweeks fescue, and Indianwheat sometimes furnish considerable forage. However, production of annuals is most dependable during a summer period of 1 month to 6 weeks.

Perennial grasses are preferred by cattle and may be used yearlong as a source of forage (*4*). In the spring when rainfall is favorable, Santa Rita threeawn grows rapidly and is especially favored as forage. In the summer and early fall, many species of perennial grasses are grazed. As the plants mature, however, cattle become more selective. For example, black grama, curlymesquite, and bush muhly are preferred in the late fall and winter. Ranges with a high proportion of black grama are especially adapted to use during late winter and spring, because black grama retains its nutritive value better than most perennial grasses.

Many species of shrubs are palatable, including falsemesquite, Wright eriogonum, velvet mesquite, shortleaf baccharis, and range ratany. Shrubs are especially preferred from fall to late spring when other vegetation is usually dry. At lower elevations shrubs are grazed throughout the year; hence they may furnish the bulk of the forage.

RANGE CONDITION

Range condition is a term used to describe range health. Every range has a given potential for production as determined by climate and soil under longtime proper grazing use. The position of a range relative to its potential can be stated in terms of different condition classes. Thus, a range in excellent condition is producing at its potential consistent with longtime grazing use. Important factors affecting productivity of grass-shrub ranges are weather, mesquite or other woody plant invaders, grazing, rodents, and rabbits.

Effect of Weather

Drought periods, particularly if they continue for three or more consecutive years, can bring about a deterioration in plant composition, vegetational cover, and herbage production (fig. 6). Species most susceptible to drought include tanglehead, Rothrock grama, and slender grama. During protracted droughts, even such highly resistant species as black grama may be severely affected.

A year of above-average moisture may produce an abundance of annuals and short-lived perennials and increase the vigor of the long-lived perennials. If the favorable moisture continues for two or more successive years, new plants of the better, longer lived species will become established.

Speed of range recovery depends upon the seriousness of a drought. If it is a prolonged one, the plants should be given an

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Figure 6.—Great yearly variations occur in forage production on grass-shrub ranges of southern Arizona. *A*, In 1948, less than 10 pounds of perennial grass per acre were produced; *B*, in 1950, more than 300 pounds per acre; *C*, in 1952, only 100 pounds per acre.

opportunity to recover. Range condition will improve much more quickly if grazing use is kept light for a year or two.

Effect of Shrubs

The spread and thickening of undesirable shrubs have an important influence on range productivity. Mesquite, cacti, and burroweed are the most serious invaders, but the effect of mesquite is known best.

Mesquite has increased greatly in the past 50 years and has spread from its original habitat along drainage channels and arroyos to the uplands (fig. 7). Dissemination of seed by grazing cattle is largely responsible for the recent spread (*12*). Mesquite furnishes some forage, especially during the season of seed production, but

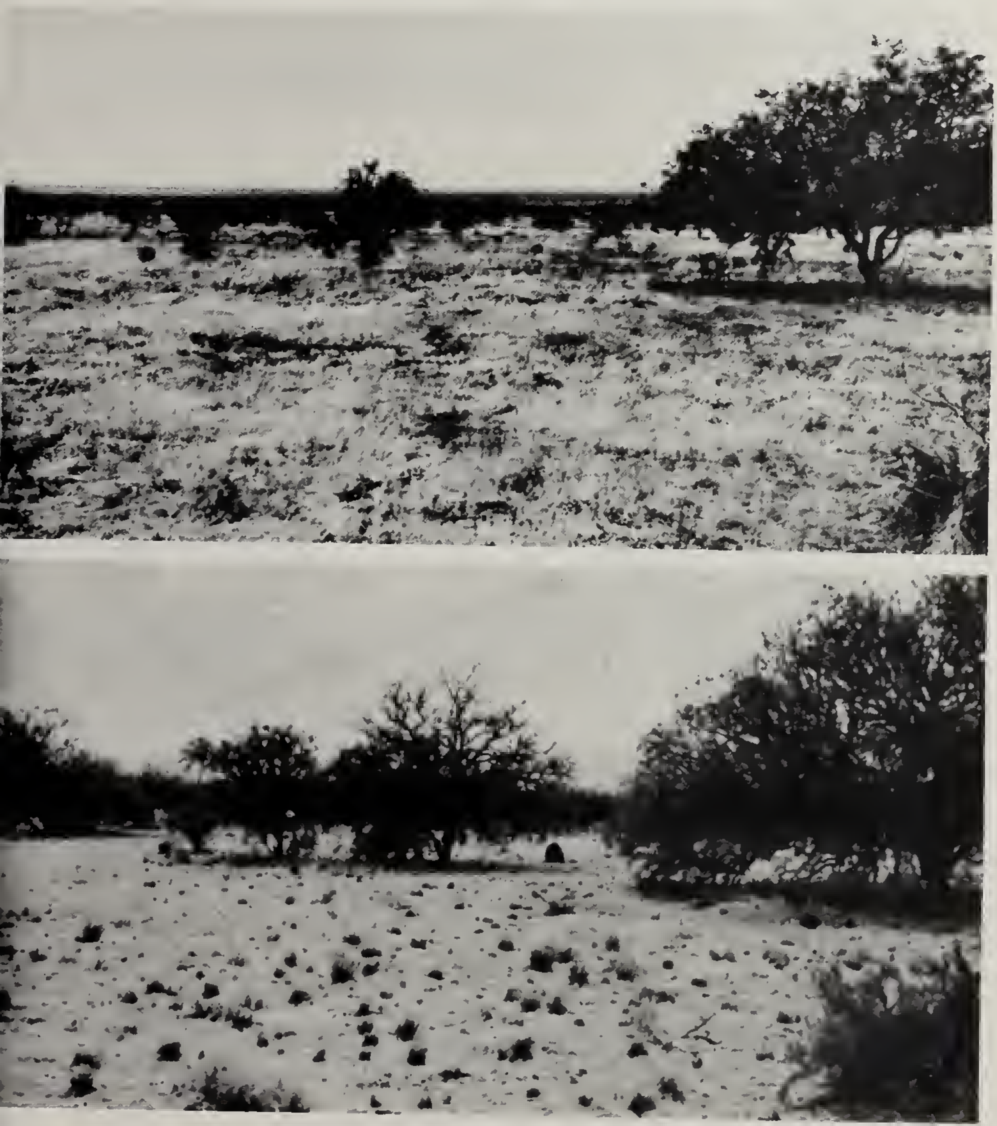

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FIGURE 7.—Mesquite spreads rapidly when seeds are abundant. At this site, mesquite has increased greatly in a period of 18 years.

not enough to compensate for the loss of perennial grass (fig. 8). Because mesquite lowers forage production, fewer animals must be grazed to avoid injury to perennial grasses.

A comparison of cattle stocking of two range units on Santa Rita Experimental Range over an 11-year period illustrates the effect of mesquite invasion upon cattle production. Mesquite made up 21 percent of the vegetation as measured by crown spread in 1937 on one unit, whereas mesquite made up only 8 percent of the composition in the other unit. In the more heavily infested unit, mesquite increased rapidly, and in 11 years the site was densely occupied by mesquite. In the lightly infested unit, the increase of mesquite was much slower. The more heavily infested range could support only 40 percent of the livestock it supported 11 years earlier. The slow spread of mesquite in the lightly infested range did not materially affect production, and stocking was maintained at a more nearly constant rate for the same period.

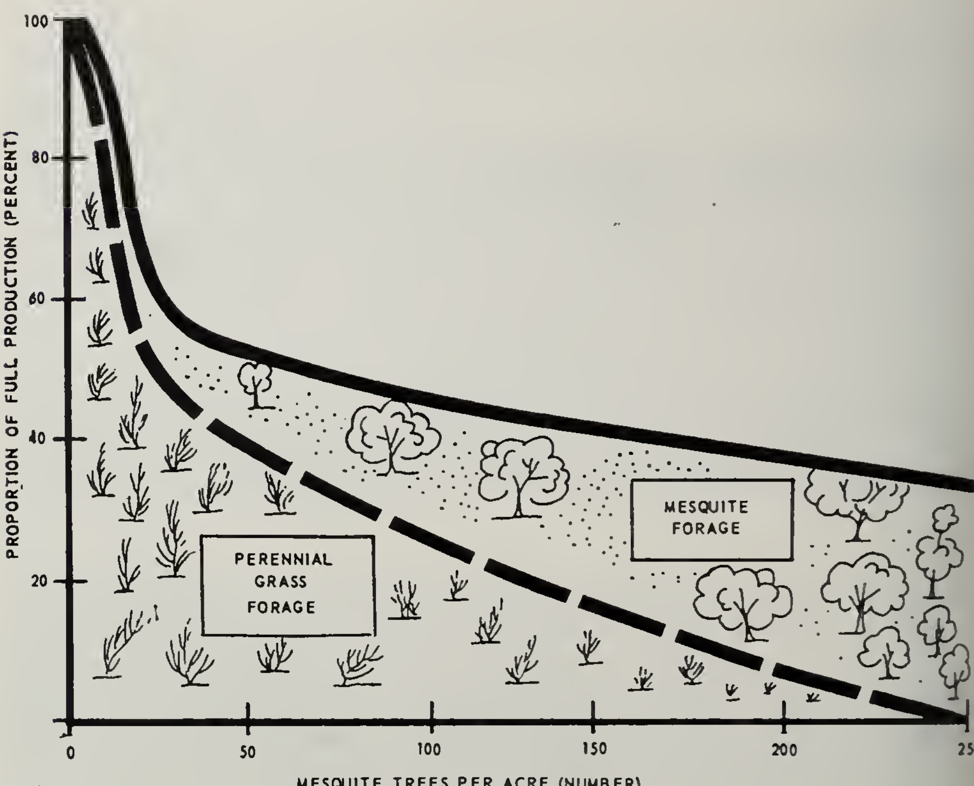

FIGURE 8.—Relation of mesquite abundance to forage production (*20*).

Effect of Grazing

Grazing influences vegetation chiefly as a result of herbage removal. In order to maintain healthy and vigorous forage plants, sufficient leafage must be left after grazing to provide for food manufacture and storage and to protect the plants during dormancy.

The need for maintaining sufficient leafage to sustain plant production is illustrated by a clipping study made on Santa Rita Experimental Range over a 9-year period. One treatment consisted

of clipping perennial grasses (hairy, sprucetop, and slender grama, and curlymesquite) to a height of 1 inch at weekly intervals during the growing season. This removed most of the leafage at a time when the plants were manufacturing food for growth and storage. Herbage production of these plants was compared with another group of plants clipped to the same height at the end of the growing season. Over the period of 9 years, plots clipped at weekly intervals produced an average of only 53 percent as much total herbage as plots clipped only at the end of the growing season. The decrease in herbage production was similar in all four species treated.

Plant species on grass-shrub ranges vary greatly in their palatability, and cattle tend to select and graze the preferred species closely. As these plants lose vigor and die where grazing is excessive, they are replaced by species that are less palatable or more resistant to grazing. Thus, selective grazing changes plant composition.

An example of how cattle grazing can change plant composition is shown by comparing vegetation inside 15 ungrazed enclosures with that in adjacent plots grazed continuously yearlong for approximately 25 years. Plant composition inside and outside the enclosures was similar when the enclosures were established. Grazing removed about half the total production of all perennial grasses each year; however, certain species were grazed much heavier than this. Species most abundant under continuous yearlong grazing were curlymesquite, Rothrock grama, and slender grama (table 2). Those favored by protection from grazing were Arizona cottontop, bush

TABLE 2.—*Composition of perennial grasses on areas protected from grazing for approximately 25 years and on adjacent areas grazed continuously*

Species	Grasses at high elevations		Grasses at intermediate elevations	
	Protected areas	Grazed areas	Protected areas	Grazed areas
	Percent	*Percent*	*Percent*	*Percent*
Arizona cottontop	31	6	26	2
Bush muhly	0	0	11	(1)
Curlymesquite	1	13	0	0
Grama:				
Black	7	5	26	15
Hairy	3	2	0	0
Rothrock	2	12	7	64
Sideoats	10	6	2	(1)
Slender	15	49	1	5
Threeawns	9	5	14	10
Tanglehead	5	1	3	3
Other grasses	17	1	10	1
Total	100	100	100	100

Basis: basal area.

[1] Less than 0.5 percent.

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muhly, black grama, sideoats grama, threeawns, and a variety of less abundant grasses, such as plains lovegrass and green sprangletop.

Another study (*6*) has demonstrated that the number of new plants produced by perennial grasses is influenced by grazing. Wolftail, Rothrock grama, sprucetop grama, slender grama, and curlymesquite produced more new seedlings where grazed than where protected. In contrast black grama, sideoats grama, hairy grama, and tanglehead produced more new plants where protected from grazing. The same study indicated that grazing reduced the average life span of wolftail, black grama, hairy grama, sideoats grama, tanglehead, mesa threeawn, and Arizona cottontop, and extended the life of Rothrock and slender gramas and curlymesquite.

The objective of grazing management is to maintain a continuous and abundant supply of good quality forage. Therefore, a range in good condition must have a fairly stable population of highly productive perennial grasses. Such preferred species as Arizona cottontop, bush muhly, black grama, hairy grama, and sideoats grama produce a more stable source of forage and are better able to withstand periodic droughts.

Effect of Rodents and Rabbits

Rodents and rabbits use vegetation that would otherwise be available for livestock and thereby lower overall grazing capacity of a range. For example, on Santa Rita Experimental Range in 1937, rodents and rabbits were estimated to consume about two-fifths of the total forage produced (*8*). Animal numbers for the entire experimental range, and estimated forage consumption, were as follows:

	Animals	*Forage consumed per animal per year*	*Forage consumed per year*
Species:	*(no.)*	*(lbs.)*	*(lbs./acre)*
Allen jackrabbit	10, 300	175. 20	35
California jackrabbit	620	120. 45	1
Arizona cottontail	3, 530	54. 75	4
Roundtail groundsquirrel	29, 780	8. 21	5
Bannertail kangaroo rat	87, 125	5. 53	9
Merriam kangaroo rat	42, 025	2. 41	2
Total	--------	--------	56

Rodents and rabbits can be more detrimental to range vegetation than cattle because they graze much closer and may even dig up root systems during dry periods (fig. 9). Also, certain species, particularly kangaroo rats, help establish unwanted shrubs by disseminating the seeds (*18*). Jackrabbits and some kangaroo rats are most abundant on ranges in poor condition and therefore have their greatest effect on these ranges.

Not all rodents are detrimental to rangelands. Many species are rare, or they graze plants that are not used by cattle.

When rodents and rabbits are present in such numbers that they seriously damage the range, control becomes desirable. Any control program should be planned and supervised by a competent biologist.

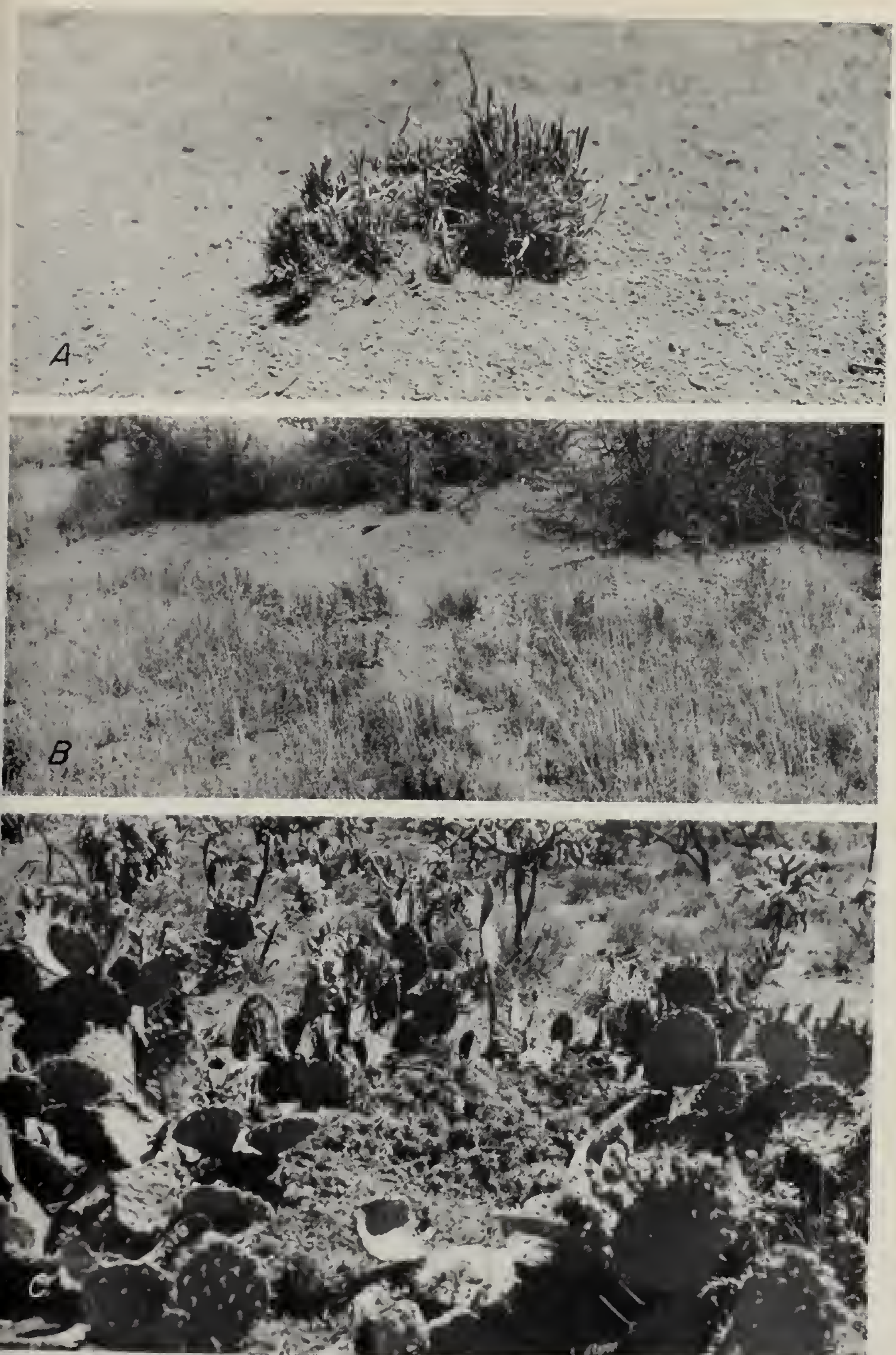

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FIGURE 9.—*A*, Rabbits are particularly destructive on grass-shrub ranges because they graze more closely than livestock. *B*, Bannertail kangaroo rats may completely destroy perennial grass within 20 to 50 feet of home burrows. *C*, The white-throated woodrat is numerous on deteriorated ranges, mainly because of the abundance of cactus and mesquite that provide food and homesites.

Judging Range Condition

An experienced observer can classify condition of grass-shrub range by visual inspection. For example, he can note such characteristics as plant species, accelerated soil erosion, ground cover (living and dead), and plant vigor. He compares these with the same characteristics on a range in top condition.

Photographs and fence-line contrasts are helpful in making comparisons, and extremes in range condition are often reflected in condition of the grazing animals (fig. 10). However, rainfall must always be considered because in years of good precipitation lush growth on a range in poor condition may give the appearance of a range in much better condition. On the other hand, in a period of low precipitation vegetation on ranges in good to excellent condition may be sparse.

Ordinarily, five range condition classes are recognized:

1. A range in *excellent condition* has a good mixture of palatable perennial grasses; plants are vigorous and reproducing well to provide a good cover of living and dead material.

2. In the *good condition* class, palatable grasses still predominate but there may be some invasion of undesirable woody plants; the cover is more open; and conditions for reproduction are less favorable.

3. When a range is in *fair condition*, the more palatable perennial grasses are exceeded by less palatable species; woody plants may be abundant and reducing forage production; litter is rare and the better perennial grasses are not reproducing.

4. In *poor condition*, palatable grasses are rare and even the poorer species are not reproducing; woody plants may form the dominant aspect; and the soil is poorly covered by living or dead material.

5. When a *very poor condition* is reached, the range is almost depleted. Perennial grasses are rare; woody plants may completely occupy the site; and the cover may be reduced to bare ground or a poor cover of annuals.

Soil erosion should also be considered in evaluating range condition. Soils are well stabilized on ranges in good or excellent condition. As vegetation is thinned, erosion may increase and will usually be apparent on ranges in poor or very poor condition.

Several techniques have been worked out for the quantitative determination of range condition. An elaboration of these techniques will be found in articles already published. These techniques include the climax approach (*11*); the forage production method (*13*); and the score-card method based on plant density, composition, and vigor (*14*).

Recognition of trend in range condition is important. A rancher should know whether his range is improving, because this has a bearing upon the stability and future of his enterprise. Trend in range condition can be determined best by measurements or observations on the same area at 3- to 5-year intervals. Allowance should be made for rainfall received in the meantime. An upward trend during a series of wet years or a downward trend in a series of dry years is not as meaningful as an upward trend during a series of dry or about average years.

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[F]IGURE 10.—*A*, This range is in excellent to good condition; plants in excellent vigor and abundance, stable soil. *B*, Fair to poor condition; plant cover reduced, undesirable half-shrubs abundant, sheet erosion evident. *C*, Very poor condition; perennial grasses and topsoil almost gone, gully erosion beginning.

BASIS FOR STOCKING

Ranges vary greatly in their capacity to support cattle, because of differences in soil productivity, amounts and patterns of rainfall, topography, and other conditions. Accordingly, each range should be stocked on its own merits.

Average yearlong animal units per section for the grass-shrub type on Santa Rita Experimental Range from 1915 to 1949, inclusive, were as follows: high elevations, 15 to 18; intermediate elevations, 12 to 15; low elevations, 6 to 9. Table 3 presents estimates of stocking rates for these three elevations in relation to range condition, based on actual stocking records and differences in forage production.

The figures in table 3 may be useful as initial stocking guides for grass-shrub ranges similar to the Santa Rita range, provided that variations are recognized and nonusable or waste range is excluded from initial computations. On the Santa Rita, distribution of livestock by watering, salting, and range subdivisions was better than average for grass-shrub ranges so that virtually full stocking of the units was attained. On more moist areas, higher stocking may be possible, and on drier ranges stocking will be less.

TABLE 3.—*Estimated average yearlong stocking rate, by condition class, Santa Rita Experimental Range*

Elevation and stocking	Range condition		
	Very poor [1]	Poor and fair	Good and excellent
High elevations:			
Animals per square mile	<15	15–20	20–25
Acres per animal	>40	30–40	25–30
Intermediate elevations:			
Animals per square mile	<10	10–15	15–20
Acres per animal	>60	40–60	30–40
Low elevations:			
Animals per square mile	<6	6–8	8–10
Acres per animal	>100	80–100	60–80

[1] $<$ signifies "less than"; $>$ signifies "more than."

FORAGE UTILIZATION

Efficient use of a range depends on proper utilization of the forage crop. The initial stocking should be based on range condition and productivity of the site, and adjusted annually and periodically thereafter. Making proper use of the forage crop necessitates (1) grazing at an intensity that will allow for growth of the main forage species; (2) grazing when herbage is most nutritious; and (3) distributing the grazing animals for full use.

Proper Degree of Use

In a period of approximately 2 months, perennial grasses must manufacture enough food to complete growth, produce seed, and store nourishment for the remainder of the year and the following spring. Grazing leaves and stems too closely can severely interfere with food production, storage, and protection of dormant buds.

Proper use factors have been determined by observing the amount of herbage that can be removed without damaging individual plants. In defining proper use factor for a species, only average plants are considered. Even with proper utilization of a range, many plants remain ungrazed; some are lightly grazed; and others are closely grazed. The percentage of weight that may be removed refers to normally healthy plants. Unthrifty plants resulting from unfavorable site, drought, or previous severe use should be given lighter use; and conversely, on especially favorable sites plants might stand somewhat heavier use. Average proper use factors for important species of the grass-shrub range in satisfactory condition under yearlong grazing are as follows (*15*):

Species:	*Weight herbage removal (percent)*
Arizona cottontop	40
Bush muhly	35
Curlymesquite	40
Dropseeds	35
Grama:	
Black	45
Hairy	45
Rothrock	55
Sideoats	45
Slender	50
Sprucetop	40
Tanglehead	40
Threeawns	50
Wolftail	40

These values have proved satisfactory from the standpoint of range maintenance on the Santa Rita. They indicate that about 40-percent utilization of desirable species is generally satisfactory for grass-shrub ranges in the southwest.

Seasonal Grazing

Seasonal grazing is an important factor in proper use of the forage crop. There are several possibilities for making seasonal use of grass-shrub ranges, based upon the forage preference of cattle. Also some plants, particularly perennial grasses, benefit from seasonal as opposed to yearlong use. Thus, both the preferences of cattle and the responses of plants can be considered in developing plans for seasonal grazing use.

Using Forage Classes in Combination

Perennial grasses, annual grasses, and browse have somewhat different growth periods. As a result there is some variation in time of highest nutritional level among these classes of forage.

Preferences of cattle rather closely follow the times of highest nutritional level. Where the different classes of forage exist in combination, seasonal shifts in grazing offer possibilities for best use of the forage. One example is a range where elevational site differences produce annual grasses, perennial grasses, and browse on different areas that can be used in combination. The amount of use in combination will be limited by the relative amounts of the various classes of forage and the possibilities of controlling herd movements.

Late in the spring, browse ranges are the only ones that furnish any large amount of green forage. They can be used profitably at this time in combination with dry annual or perennial grasses that serve as bulk forage. When summer rains commence, green annuals are ideal forage, and cattle graze them with relish. Their nutritive content is high, and the plants can stand considerable grazing before it interferes with setting of seed. Lower ranges provide an excellent opportunity for concentrated grazing in the summer because of the annuals produced. If cattle are grazed yearlong on such ranges, they must graze for long periods on dry forage. As annuals begin to dry, cattle can be shifted to ranges where perennial grasses are abundant.

Most perennial grasses are palatable during the fall and maintain their food value fairly well. Black grama, particularly, maintains its nutritive value well into the winter. Also, as will be discussed later, summer deferment is especially beneficial to this species. Thus, the general objective of management should be to get maximum summer use of annuals, fall and winter use of perennial grasses, and spring use of browse.

Where velvet mesquite is present, particularly on intermediate and higher elevations, special management should be adopted. Cattle graze its leafage whenever it is available, but they especially seek out the nutritious bean pods produced in late spring and summer. Because viable beans are spread in cattle droppings, areas where mesquite predominates should be fenced off from good grassland and utilized separately wherever possible.

Summer Deferment Versus Yearlong Grazing

Summer deferment benefits the desirable perennial grasses. The following tabulation shows how the proportions of species changed under two treatments between 1937 and 1948 on a unit of Santa Rita Experimental Range:

Treatment and perennial grass species	*Composition* 1937 (percent)	*Composition* 1948 (percent)
Summer deferred:		
Desirable species:		
Arizona cottontop	0	6.1
Black grama	6.1	11.1
Bush muhly	0	1.0
Tanglehead	1.5	22.2
Santa Rita threeawn	29.3	27.3
Other	0	1.0
Total	36.9	68.7

Treatment and perennial grass species	*Composition* 1937 (*percent*)	1948 (*percent*)
Less desirable species:		
Rothrock grama	46.2	19.2
Threeawns, misc	16.9	12.1
Total	63.1	31.3
Total perennial grasses	100.0	100.0
Grazed yearlong:		
Desirable species:		
Arizona cottontop	3.1	15.5
Grama:		
Black	16.1	15.0
Sideoats	1.0	3.1
Sprucetop	3.5	1.0
Bush muhly	2.4	4.3
Tanglehead	.7	6.9
Santa Rita threeawn	34.1	24.9
Other	3.8	1.0
Total	64.7	71.7
Less desirable species:		
Grama:		
Rothrock	12.3	10.8
Slender	13.4	6.9
Threeawns, misc	9.6	10.6
Total	35.3	28.3
Total perennial grasses	100.0	100.0

Under summer deferment, grazing was from November through March each year, when the perennial grasses were mostly dormant. Over the 11 years, this range showed greater improvement than the idjacent check range grazed yearlong. Desirable grasses increased from about one-third of the perennial grasses to two-thirds whereas the less desirable grasses decreased from about two-thirds to one-third of the composition. Arizona cottontop, black grama, tangle-iead, and bush muhly, all increased. Rothrock grama, a less lesirable grass, decreased from about one-half of the total stand to ibout one-fifth.

The check range grazed yearlong was in better condition in 1937. It was also grazed conservatively during the study period. Under his type of use, the relative abundance of the desirable grasses in-ereased slightly. They made up 65 percent of the perennial grasses n 1937 compared with 72 percent in 1948. The relative abundance of Arizona cottontop, bush muhly, sideoats grama, and tanglehead, ll desirable grasses, increased materially. However, black grama, prucetop grama, and Santa Rita threeawn decreased. Rothrock rama and slender grama, less desirable species, also decreased in elative abundance but not to the same extent as on the range receiving ummer deferment.

Black grama is very palatable and it is perhaps the most important ingle species of grass-shrub ranges. Because it spreads by above-round runners or stolons during the growing season, the species s severely restricted if these runners are grazed. Accordingly,

where black grama makes up a high proportion of the perennial grass composition, summer deferment is particularly beneficial.

On a well-managed range near Sonoita, Ariz., grazing is deferred during the summer growing season on one-fifth of the range each year, and the area deferred is rotated so that each area is rested once in 5 years. The excellent condition of this range testifies to the advantages of this recommended method of deferred grazing in combination with conservative stocking.

Proper Distribution of Animals

Full use of grass-shrub rangelands depends on proper distribution of grazing. Natural concentration sites such as salting areas, resting ground, ridges, bottoms and areas near trails, and watering places receive the heaviest grazing. Utilization tends to decrease with increasing distance from these sites. Studies made on Jornada Experimental Range in southern New Mexico show the relation of utilization to distance from water (*3*). On the range as a whole, black grama was greatly overutilized at water, about properly utilized at 1½ miles from water, and used only 40 percent of the proper degree at 3 miles from water. On lightly used ranges, heavy grazing of black grama was confined to ½ mile from water, on conservatively grazed ranges, to within 1 mile; but on heavily grazed ranges it extended to 3 miles.

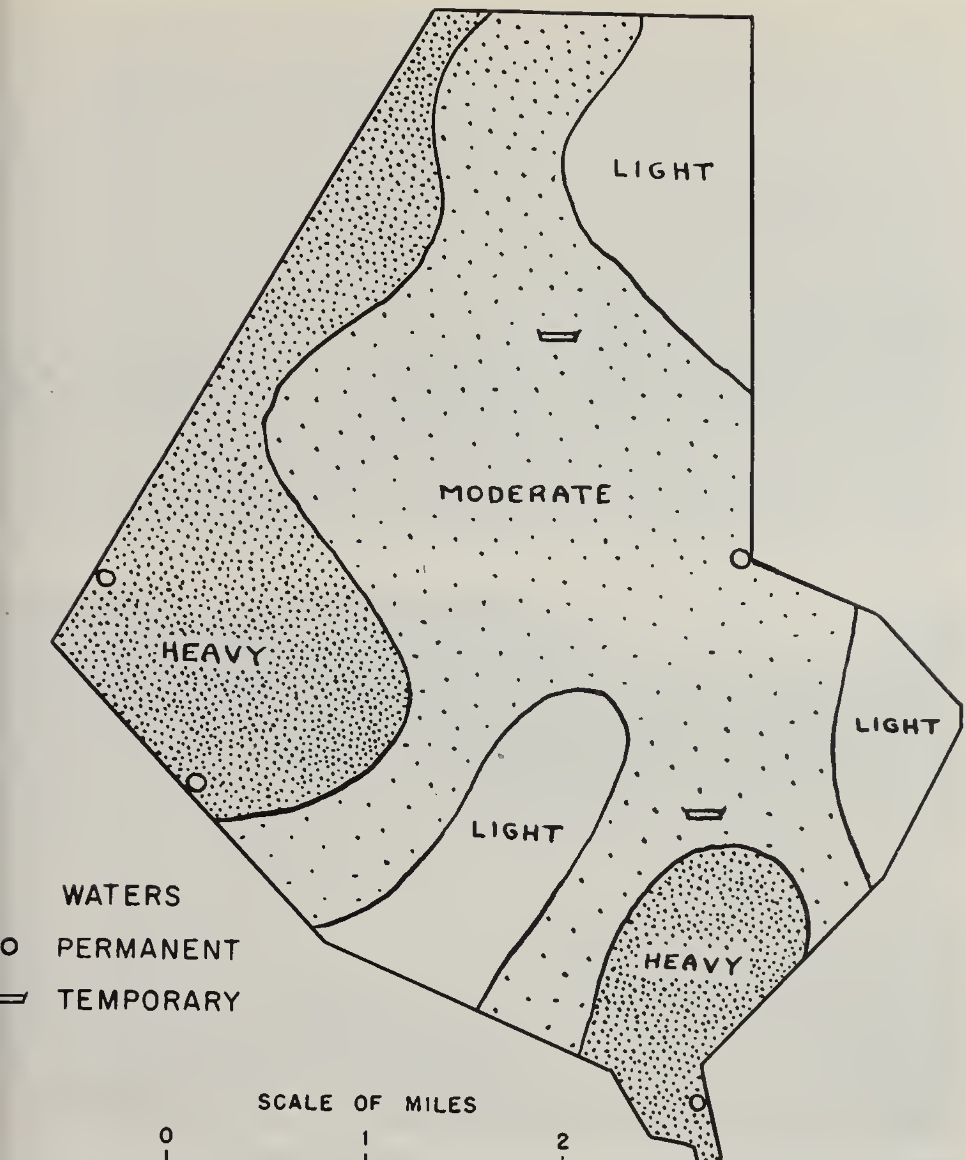
Obtaining uniform distribution is not always a simple matter even where water is well distributed. This is illustrated in figure 11. Several range management practices can be used to improve distribution of grazing animals. These include watering, salting, supplemental feeding, and subdividing the range by fencing.

Watering

In the naturally dry climate of grass-shrub ranges, special attention should be given to the watering plan. As a minimum requirement, fairly permanent and dependable watering places should be 4 to 5 miles apart on flat and undulating land, 3 miles on rolling ranges, and 1 to 2 miles where the terrain is rough (*23*). When this requirement is met, costs largely determine the desirability of further water development.

The more watering places available within practical limits (fig. 12), the more uniform the utilization of forage. Once a primary network is established, many small watering places are better than a few large ones. Small, inexpensive watering places can often be constructed merely by throwing up a dirt embankment across a small gully or surface drainage, with provision for overflow. For large water impoundments, competent engineering advice is indispensable.

More uniform use of the range can also be achieved by hauling water, particularly during dry years. Where unused forage is available and the haul is not too great, it has proved to be a practical and profitable practice. On the experimental range, water was hauled 18 miles at a cost of 3 cents an animal day. Cattle used an



IGURE 11.—Pattern of grazing at the end of the 1941 grazing season for a range unit of about 10,000 acres at an intermediate elevation on Santa Rita Experimental Range.

verage of 8 gallons of water a day. This made use of the range ossible during drought when many of the tanks failed to catch ater. Because of such advantages, water hauling is becoming a mmon practice on many western ranges (7).

Since water is often the primary factor limiting use of forage, ncing permanent waterholes can facilitate proper utilization. In me circumstances summer deferment of grazing can be achieved closing access to waters. It is most practical to close off perانent watering sites while temporary waters are available. Otherise, full use of temporary water and utilization of the surrounding nge may not be possible.

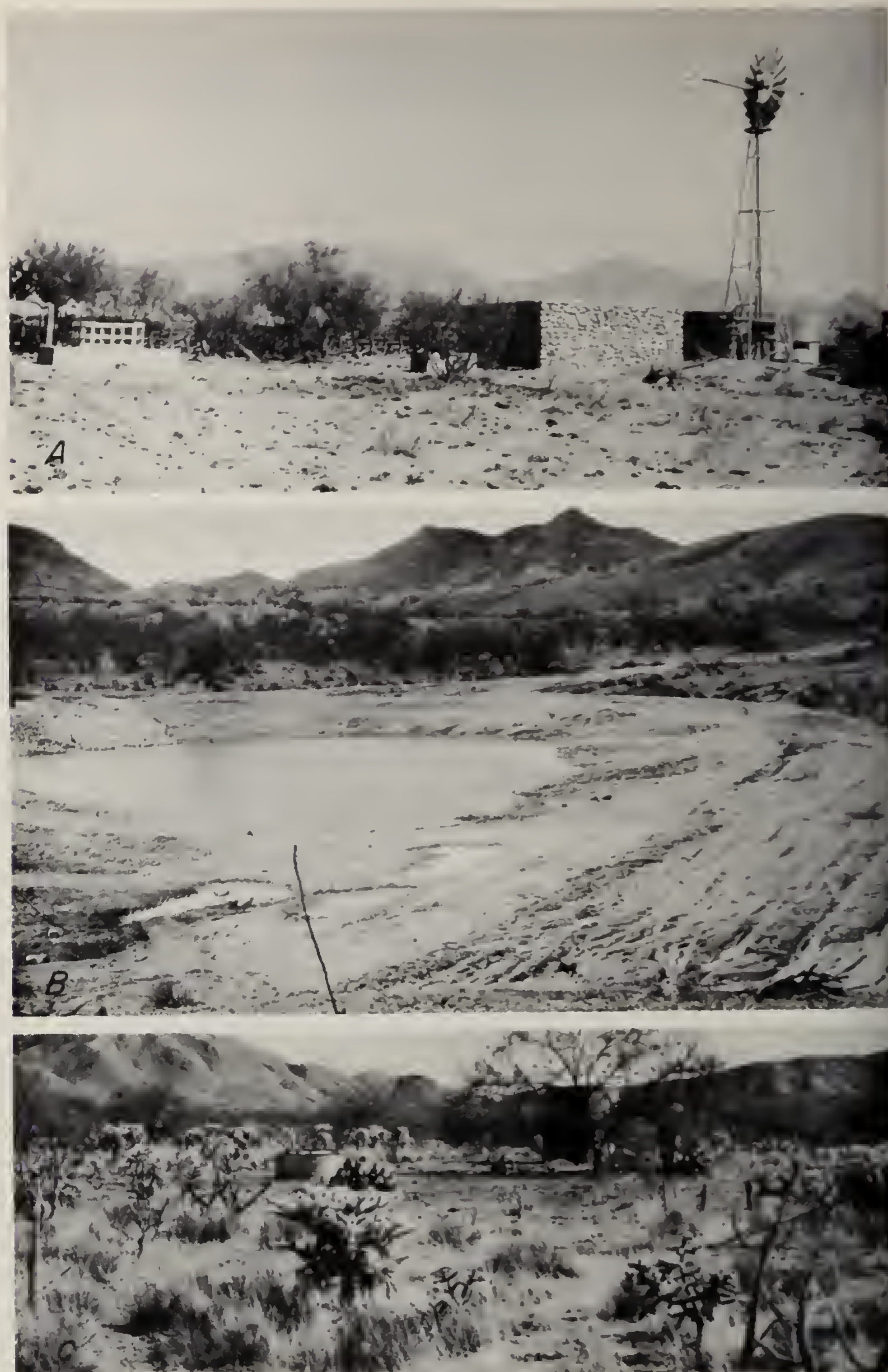


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FIGURE 12.—Three kinds of watering places: *A*, Permanent and dependable water to assure availability of water in each pasture; *B*, temporary surface tanks to improve distribution; *C*, storage tank and trough for hauled water to improve distribution and augment other water sources, especially during drought.

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FIGURE 13.—Proper placement of salt, especially during summer and early fall, helps to equalize distribution of cattle and to spread grazing to areas that may be underutilized.

Salting

Placement of salt away from water can extend the areas of proper utilization (fig. 13). This increases the number of animal units that a range can properly accomodate.

On the Jornada, salting away from water reduced utilization near water, and increased it about 10 to 15 percent at distances of more than 3 miles from water (*3*). During the summer when forage is green, about 2½ pounds of salt for an animal-unit month is usually needed (*22*). After forage matures, 1½ pounds of salt a month is sufficient. Annual salt requirement on yearlong ranges amounts to about 25 pounds a cow.

Supplementing

The judicious placement of supplements such as salt-meal mix and cottonseed cake will draw animals into lightly used areas (*2*). This practice is especially desirable during winter and spring when natural vegetation is low in nutritive value. "Supplementing" should be only what the name implies—adding something to the forage. Range supplementing should not be used to carry more animals than the forage supply will justify.

Range Subdivisions

Utilization can be improved by providing ranges of a size to accommodate 50 to 100 animals. This arrangement makes it easier to handle livestock and permits closer supervision. By subdivision, it is also possible to make better use of forage or to use the range seasonally.

Better calf crops often result from range subdivision. This is illustrated by records for two pastures on Santa Rita Experimental

Range *(10)*.[4] One pasture contained 10,000 acres; the other, 7,800 acres. In 1937, the smaller one was divided into pastures of 3,200 and 4,600 acres. All calf crops improved somewhat in the 1937–45 period, but the increase was considerably greater in the subdivided pasture:

Period:	Pasture and treatment	Size (acres)	Calf crop (percent)
1926–36	I. No treatment	10, 000	80. 1
	II. do	7, 800	75. 8
1937–45	I. No treatment	10, 000	85. 9
	II. Subdivided:		
	Part A	3, 200	92. 4
	Part B	4, 600	88. 1
	Average	--------	90. 2

Judging Proper Use

An annual survey of the range is desirable to determine whether the range is properly utilized. This requires decisions as to when, where, and how utilization is to be judged.

When to Judge

If only one check of utilization is made annually on ranges grazed yearlong, it should be during June. New growth commences in July. After this, recognition of utilized plants and general patterns of utilization becomes difficult. Utilization checks can also be used to determine whether it is necessary to shift animals from one range unit to another. These can be made any time after the growing season. When stocking adjustments are anticipated, a utilization survey in January or February is desirable. The amount of grazing remaining on the range for the same number of cattle can be determined by the following formula:

$$12 \text{ months} \times \frac{\text{proper utilization} - \text{observed utilization}}{\text{proper utilization}} = \text{number of months of grazing remaining}$$

In this relationship, utilization is expressed in percent.

Where to Judge

Utilization should be measured at either random or mechanically spaced intervals over the entire range. At least 16 samples should be located in each range unit. When a unit is larger than eight General Land Office sections, at least two sampling units per section should be taken (*5*). An average of all samples will give the average use of the unit. Zones of approximately equal utilization can be mapped to indicate needs for improving distribution.

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[4] Cattle used in this study were privately owned, and were grazed under cooperative agreement from 1926 to 1945.

How to Judge

A simple, practical, and inexpensive method for measuring utilization is to determine percentage of grazed and ungrazed plants (*21*). Percentage of herbage removed from a range is closely related to the number of plants grazed. The relation between percentage of grazed plants and total percentage of use by weight should be checked annually for each key species.

The grazed-plant method requires no special equipment or training. For each species, plants are selected merely by pacing in a predetermined course, and the one nearest the right foot at the end of each pace is recorded as grazed or ungrazed. Percentages of grazed and ungrazed plants are determined directly when 100 plants are recorded. By reference to an established relation (fig. 14), percentage of utilization by weight for the sample can be determined. For example, if the survey showed 50 percent of the plants to be ungrazed, the chart shows that 36 percent of the herbage by weight was removed from the range. Also, by relating percentage of grazed plants to changes in range condition, proper levels of utilization can be determined for other ranges. Preferred species should be properly utilized if range condition is to be maintained or improved.

Making Stocking Adjustments

Proper utilization requires that 45 to 65 percent of the herbage produced by the better perennial grasses be left on the range each year. Large differences in herbage production from one year to the next, especially at low elevations, create the problem of how to stock in order to attain this goal.

The first requisite is stocking at a conservative level to allow for the effects of slight droughts. For example, if stocking is set at about 20 percent below average forage production, it can remain at this rate about 65 percent of the time. During the remainder of the time, adjustments will be necessary because of scarcity of forage or to take advantage of an abundance of forage (*17*).

There are several possible management systems for stocking grass-shrub ranges where the forage supply varies greatly. The most conservative approach is an exclusive cow-calf operation in which breeding animals do not exceed the number that would consume on the average 40 percent of the forage produced by the better perennial grasses. This system insures adequate forage except during the most severe drought, but it would make inefficient use of forage more than half of the time. The most liberal system would utilize all of the forage produced each year. This could conceivably be accomplished by annually purchasing weaners or older animals for full consumption of the available forage supply.

The most practical solution to stocking is some compromise between the ultraconservative and liberal systems. One system that has worked well on grass-shrub ranges is to reduce the number of breeding animals in the herd to 40–60 percent of the total. The excess forage during above average years is utilized by holding over weaners or by purchasing growing animals from some other source.

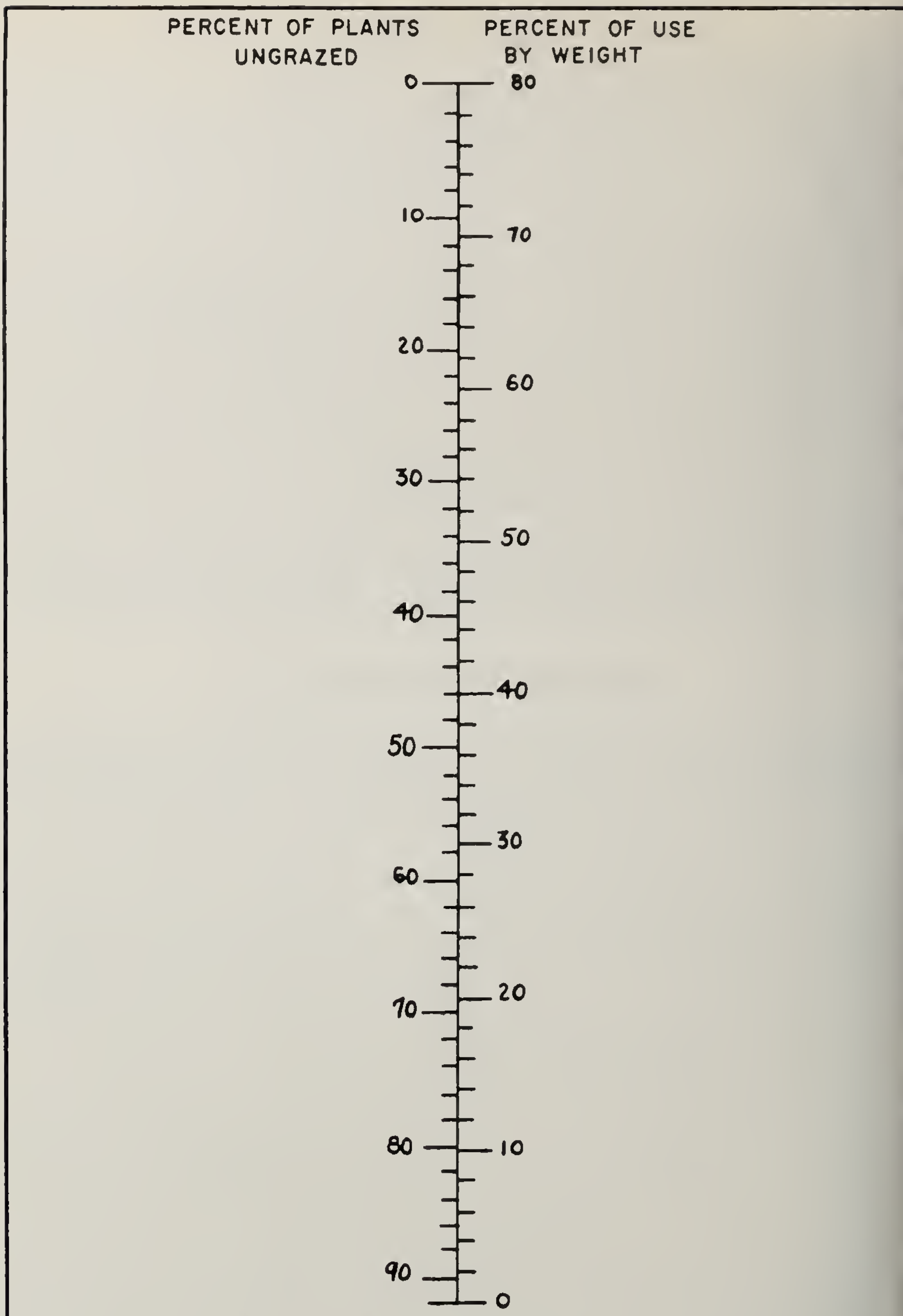

FIGURE 14.—Chart for approximating percent utilization by weight when average percentage of grazed or ungrazed key species has been determined by survey (*21*).

During dry years, all except breeding animals are sold. Such a system minimizes the adjustments necessary in the breeding herd, which may upset the results of years of effort in selection and grade improvement.

PROPER HANDLING OF LIVESTOCK

Methods of handling livestock have much to do with keeping grass-shrub ranges in good condition and maintaining high sustained production. Top production depends on proper husbandry of good animals. This section deals with some of the tested procedures that have benefited the range, the livestock, or both.

Adherence to a definite breeding season has many advantages. In the early days it was common practice to run the bulls with cows yearlong. Until 1936, this was the practice on Santa Rita Experimental Range. A regular breeding season of April through October was adopted in 1936. This resulted in a greater percentage of early calves and heavier calves at marketing time. Also, it reduced the number of late calves that had to be carried over for another year before marketing. Greater uniformity in calf weights resulted in better unit prices and higher overall income. The production of early calves also permitted cows to go into the winter in much better flesh.

Different ratios of cows to bulls have been tried on the experimental range, varying from 12 to 1 up to 25 to 1. No significant difference in calf crops was found within these limits for this range of gentle topography.

Under range conditions, breeding cows should be culled from the herd when between 8 and 10 years old; and bulls, when they are about 7 years old. It has proved to be a waste of forage and a loss in productivity to carry animals when they are no longer in top condition for reproduction.

Gentle methods and modern conveniences for handling livestock greatly reduce losses and injuries. Cattle are mostly injured by rough handling and roping on open range. Modern conveniences for doctoring, dehorning, and handling have lowered cattle losses substantially (fig. 15). Also, holding traps, corrals, squeeze and separating chutes, and branding tables greatly reduce labor costs. Trucking has now almost completely replaced trailing to shipping points. Better returns from trucking come from lower labor costs, less shrinkage in market animals, reduced injuries, and less weight loss among breeding cows.

RANGE IMPROVEMENT PRACTICES

Many ranges fail to produce maximum amounts of forage because of past use and shrub invasion. As greater production per unit area of grass-shrub ranges is demanded, measures for restoring ranges to full production will be adopted. This may require revegetation, shrub suppression, or both, in addition to the other range management practices previously discussed. Methods are now available for restoring some ranges, although all methods are costly. Better methods are also being developed.

Shrub Suppression

Of the invading woody plants that are seriously lowering range conditions, mesquite is the most detrimental (*16*). Choice of the best method for suppression depends upon many factors such as

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FIGURE 15.—Modern conveniences for handling animals practically eliminate injuries and greatly reduce labor costs: *A*, A modern handling corral includes separating pens, a squeeze chute, and livestock scales; *B*, calf branding tables are a considerable improvement over the old method of roping out of a herd.

tage of infestation, availability of equipment, and site productivity (20). Hand grubbing by mattock is cheapest and most effective or trees less than 1 inch in diameter. Initial invasions can be handled easily by this method at a cost of only a few cents an acre. Low-grade diesel oil applied to individual trees is best for stands hat do not exceed 100 stems an acre. Properly applied, diesel oil vill give 90-percent kills at a cost of about 5 cents a tree.

Cabling or chaining reduces stand density effectively when trees re larger than 2 inches in basal stem diameter and when density xceeds 100 plants an acre. A 300- to 500-foot length of heavy nchor chain or 1-¾-inch multistrand wire cable is usually dragged etween two (D-8 or equivalent) crawler-type tractors. Two passes n opposite directions are more effective than one. In stands of nesquite exceeding 225 trees an acre, especially in rough topography, praying chemicals on foliage offers some promise. For southern rizona conditions, ¾ pound of 2,4,5-T (low-volatile ester) to the cre in a mixture of 2 gallons of diesel oil and 6 gallons of water, as proved best. Timing of spraying is important: mesquite plants re most susceptible when leaves and blossoms are in full growth nd developing pods are about ½-inch long. In some tests, up to)-percent kills have been attained.

Burroweed has also increased greatly on many grass-shrub ranges fig. 16). Invasion of this shrub is associated with declining perenial grass yields, especially of those species that grow in the spring. nder some conditions, burroweed is toxic to cattle.

Control methods have not been so thoroughly tested for burroweed s for mesquite. Where the fire hazard is not great and there is ore than 500 pounds of fuel per acre, burning has proved to be an fective method for eliminating burroweed. Up to 90-percent kills ave been attained from a range burn in June (*19*).

Cholla and pricklypear, both undesirable, are increasing on some nges. Of the two, cholla more seriously reduces the number of nimals that should be allowed to graze a range. The presence of olla makes livestock handling particularly difficult. As with burweed, fire, under appropriate conditions, can reduce the abundance cacti. For example, a single June burn killed about 40 percent the cholla and about 30 percent of the pricklypear (*19*). Individl plants can be killed by drench solutions of several chemicals, for ample, a mixture of 2,4-D and 2,4,5-T and trichloroacetate, alough treatment is expensive. Before undertaking burroweed or ctus control, the rancher should consult the local Agricultural xtension Service for the most recent information.

Revegetation

Some ranges are so seriously deteriorated that native grass will t recover in a reasonable time. Also, there are local livestock ncentration areas on nearly all ranges where the native grass has en depleted and should be restored. More and better quality rage for seasons when forage is short, particularly in the spring, desirable on some rangelands. Revegetation can correct some of ese deficiencies (fig. 17).

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FIGURE 16.—Woody plant invasion is one of the most serious problems confronting users of grass-shrub ranges. *A*, In the spring of 1919, only scattered burroweed and mesquite were evident at a 3,500-foot elevation on Santa Rita Experimental Range. *B*, By the spring of 1930, burroweed formed a dense stand and cactus was beginning to appear. *C*, By the spring of 1948, mesquite and cactus showed a remarkable increase. Unless this invasion of woody plants is suppressed, a former grassland site may be completely occupied by shrubs.

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IGURE 17.—Some rangelands can be benefited by seeding. *A*, Lehmann lovegrass (right) is most widely used for seeding because of its ease of establishment, available seed source, and resistance to grazing. *B*, Site preparation that pits the soil to provide for additional moisture retention is desirable for heavy or eroded soils. Planting with a cultipacker seeder covers seed properly.

At present, reliable seeding methods are known for the better tes on grass-shrub ranges (*1*). Fairly level sites with deep, fertile, nd medium-textured soils are best for seeding. Annual rainfall ould exceed 11 inches. If more than scattered stands of mesquite, ctus, or burroweed are present, they should be controlled before eding. Areas where seeding is contemplated should be subject grazing control, and should be a part of the overall grazing anagement plan.

The best species for seeding vary with site. Above a 4,000-foot evation and 14 inches of annual rainfall, Lehmann and Boer love-

grasses have given the most consistent success. Blue grama, Arizona cottontop, and black grama are also good species but more difficult to establish. There are no commercial seed sources for the last two species. On upland sites where annual rainfall averages 11 to 14 inches, only Lehmann lovegrass has been established consistently. On bottom-land sites or swales where moisture accumulates, blue panicum, Johnsongrass, Lehmann lovegrass, and Boer lovegrass grow well.

Soil treatment before seeding is essential for success. The main purposes of soil treatment are to remove competing vegetation, to provide for seed coverage, and to promote moisture penetration. Pitting with an eccentric disk has been the most consistently successful method. Contour furrowing and ripping have also given good results. Covering seed 1/8 inch for fine-seeded species, such as Lehmann lovegrass, to 1 inch for coarse-seeded species is recommended. A cultipacker seeder has proved best for seed coverage. May and June, just prior to summer rains, are the best months for planting.

Seeded grasses have their own special management requirements. New stands should not be grazed until after the second growing season or until seed heads have been produced on the more slowly developing species. Once seeded grasses are established, proper degree and season of use should be observed. Measures should be taken to prevent destruction of newly seeded stands by insects and rodents. Natural concentration areas for cattle cannot be successfully reseeded unless major changes in management are made.

RECOMMENDATIONS FOR MANAGING GRASS-SHRUB RANGES

1. Perennial grasses provide the most important forage on grass-shrub rangelands. Management should be aimed at maintaining a vigorous and productive supply of these grasses.
2. Among the climatic factors, precipitation has the greatest influence upon range productivity. Every effort should be made to conserve as much moisture on the site as possible to increase the growth of perennial grasses.
3. Production and composition of range vegetation varies greatly with annual rainfall and soil conditions. A rancher should recognize the desirable species and know their seasons of growth and periods of preference by livestock.
4. Ranchers should recognize and strive for the best possible range condition. The main factors affecting forage production are weather, mesquite or other woody plant invasion, grazing, rodents, and rabbits.
5. Range maintenance is dependent upon proper utilization of the annual forage crop. Annual and periodic adjustments in stocking are essential for proper use of the forage crop. Annual weight removal of perennial grasses should be between 35 and 55 percent.
6. The practice of making seasonal shifts of livestock on the range benefits both plants and animals. Where the opportunity exists summer annuals can be utilized during the summer period, perennial grasses during the winter, and browse during the spring. Black grama is particularly benefited by summer deferment.

7. Proper distribution of grazing is essential for optimum use of grass-shrub rangelands. This can be achieved by fencing range units of a size to accommodate 50 to 100 animal units, developing water to the extent practical, and using salt and supplements to draw animals into lightly used areas.

8. Periodic stocking adjustments are essential for proper use of the variable forage supply. By stocking at a conservative level, adjustments can be avoided most of the time. By maintaining a flexible herd with breeding animals making up 40 to 60 percent of the herd, downward adjustments can be made during dry years without reducing the breeding herd. In above-average years, excess forage can be utilized by holding over weaners or by purchasing growing animals from some other source.

9. A well-organized program of range improvement is desirable on grass-shrub rangelands. This should include plans for shrub suppression where there are invasions of mesquite or other undesirable woody plants such as cactus and burroweed. Also, on highly productive but severely depleted areas, forage restoration through revegetation should be considered.

COMMON AND SCIENTIFIC NAMES

Grasses

Bristlegrass, plains	*Setaria macrostachya* H.B.K.
Cottontop, Arizona	*Trichachne californica* (Benth.) Chase
Curlymesquite	*Hilaria belangeri* (Steud.) Nash
Dropseeds	*Sporobolus* spp.
Dropseed, sand	*S. cryptandrus* (Torr.) Gray
Fescue, sixweeks	*Festuca octoflora* Walt.
Fingergrass, feather	*Chloris virgata* Swartz
Fluffgrass	*Tridens pulchellus* (H.B.K.) Hitchc.
Grama:	
Black	*Bouteloua eriopoda* Torr.
Blue	*B. gracilis* (H.B.K.) Lag.
Hairy	*B. hirsuta* Lag.
Needle	*B. aristidoides* (H.B.K.) Griseb.
Rothrock	*B. rothrockii* Vasey
Sideoats	*B. curtipendula* (Michx.) Torr.
Slender	*B. filiformis* (Fourn.) Griffiths
Sprucetop	*B. chondrosioides* (H.B.K.) Benth.
Johnsongrass	*Sorghum halepense* (L.) Pers.
Lovegrass, Boer	*Eragrostis chloromelas* Steud.
Lovegrass, Lehmann	*E. lehmanniana* Nees
Lovegrass, plains	*E. intermedia* Hitchc.
Muhly, bush	*Muhlenbergia porteri* Scribn.
Panicum, blue	*Panicum antidotale* Retz.
Sacaton, alkali	*Sporobolus airoides* Torr.
Sprangletop, green	*Leptochloa dubia* (H.B.K.) Nees
Tanglehead	*Heteropogon contortus* (L.) Beauv.
Threeawns	*Aristida* spp.
Threeawn, mesa	*A. hamulosa Henr.*
Threeawn, Santa Rita	*A. glabrata* (Vasey) Hitchc.
Threeawn, sixweeks	*A. adscensionis* L.
Wolftail (Texas timothy)	*Lycurus phleoides* H.B.K.

Herbs

Deervetch	*Lotus* spp.
Heronbill	*Erodium* spp.
Indianwheat	*Plantago* spp.

Trees and Shrubs

Baccharis, shortleaf	*Baccharis brachyphylla* Gray
Burroweed	*Aplopappus tenuisectus* (Greene) Blake
Cacti	*Opuntia* spp.
Cholla, cane	*O. spinosior* (Engelm. and Bigel.) Toumey
Cholla, jumping	*O. fulgida* Engelm.
Creosotebush	*Larrea tridentata* (DC.) Coville
Eriogonum, Wright	*Eriogonum wrightii* Torr.
Ephedra, longleaf	*Ephedra trifurca* Torr.
Falsemesquite	*Calliandra eriophylla* Benth.
Hackberry, spiny	*Celtis pallida* Torr.
Mesquite	*Prosopis* spp.
Mesquite, velvet	*P. juliflora* var. *velutina* (Woot.) Sarg.
Pricklypear, Engelman	*Opuntia engelmannii* Salm-Dyck
Ratany, range	*Krameria parvifolia* Benth.
Saltbush, fourwing	*Atriplex canescens* (Pursh) Nutt.
Zinnia, desert	*Zinnia pumila* Gray

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Uniform Accounting for Locker and Freezer Provisioners

by Thornton W. Snead, Sr.
and Paul C. Wilkins

Farmer Cooperative Service
U. S. Department of Agriculture

GUIDE to

FARMER COOPERATIVE SERVICE
U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON 25, D. C.

Joseph G. Knapp, Administrator

The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, merchandising, product quality, costs, efficiency, financing and membership.

The Service publishes the results of such studies, confers and advises with officials of farmer cooperatives; and works with educational agencies, cooperatives, and others in the dissemination of information relating to cooperative principles and practices.

Acknowledgment: The National Institute of Locker and Freezer Provisioners was instrumental in bringing together a committee to consider a uniform accounting system for the industry. Thornton W. Snead, Sr., Consultant on Uniform Accounting Systems and Procedures, did the basic work under contract with Farmer Cooperative Service. Paul C. Wilkins of Farmer Cooperative Service was coordinator of the project and co-author of this Guide. Robert L. Madeira, Executive Director, National Institute of Locker and Freezer Provisioners, and J. L. Pidcock, Assistant Secretary of Marketing, Illinois Agricultural Association, made valuable contributions in planning the system.

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Guide to Uniform Accounting for Locker and Freezer Provisioners

rnton W. Snead, Sr.

l C. Wilkins

ocker and freezer provisioners are faced with increasing competition, ands for new services, and narrowing keting margins. Greater efficiency in urement, processing, and merchanig is necessary not only to the successoperation of these businesses, but, nately, to their very survival.

Recordkeeping in the industry has, in ral, failed to keep pace with changing s. The result is that most proners do not have current, accurate unting information readily at hand to help them make sound business decisions affecting the efficiency of their operations.

Better financial records would help locker and freezer provisioners operate more efficiently and thus permit lower marketing margins. This would benefit both producers and consumers. Realizing this, Farmer Cooperative Service, in cooperation with others, undertook to develop a uniform accounting system for the industry.

This Guide explains the uniform accounting system and gives instructions for operating it. Sample forms and entries illustrate basic procedures -- the emphasis is on visual presentation. The Guide is not intended to teach accounting, nor is it a textbook of accounting principles. It is, in fact, a Guide.

The LFP System

uccessful operation in this highly comive field requires maximum efficiency. , in turn, requires current, accurate mation upon which management can decisions. This Uniform Accounting em for Locker and Freezer Proners (LFP System) is designed to sh such financial information to manent.

Advantages

Adopting a uniform accounting system will enable the locker and freezer provisioning industry to develop financial, production, and other operating standards heretofore unavailable. These standards will provide guides for operators to

measure their efficiency and improve their operations.

The LFP system provides more control of labor costs and materials than is found in most of the systems that firms in this industry now use. Sales and costs of sales are departmentalized so as to arrive at gross margins by departments. Operating expenses are classified as plant, selling and delivery, and general and administrative. This information provides facts and figures which will help in planning and can lead to better management.

An important advantage will be that all provisioners using the LFP system will be speaking the same language. Cost of sales, gross margins, and operating profit will not mean one thing to one operator and something entirely different to another. Thus, provisioners will be in a better position to compare their plants and operations and, through this exchange of information, improve their efficiency.

Flexibility

The LFP system is flexible enough to meet the needs of most firms in the industry. It provides procedures for plants engaged in custom storage and processing, and in processing plant-owned products for sale. It is suitable for the various types of business organizations -- single proprietorships, partnerships, cooperative corporations, and corporations that are n
cooperatives.

Since the majority of the businesses
this industry are single proprietorshi
or partnerships, the Guide uses the
customary accounting terminology. Coo
eratives and other corporations use sor
different accounts and terminology. In t
case of a corporation that is not a coope
ative, the difference lies in the net wor
accounts. (See discussion of net wor
accounts.)

Incorporated cooperatives use st
different terminology. These organiz
tions use the term "revenue" instead
"income"; "net savings" instead of "n
profit"; and "undistributed savings"
place of "surplus." The major net wo
accounts for incorporated cooperativ
also are shown in the net worth section
this Guide.

Most firms in the industry do not ha
accountants trained to operate compl
cost accounting systems. The LFP syst
has been designed, therefore, to be us
by anyone with a knowledge of double en
bookkeeping. The importance of cost a
speed in providing information for ma
agement also has been kept in mind.

Firms adopting the LFP uniform syst
probably will need to make some chang
in their recordkeeping. Generally the
changes will be minor and will be in acco
ance with accepted accounting procedure

Operating Statement and Balance Sheet

The operating statement and the balance sheet (statement of assets, liabilities, and net worth) are the immediate end results of recordkeeping or accounting. However, this Guide presents them first rather than last. Why? Because seeing the finished product should make it easier to understand the accounting procedures and the forms used.

Explanation

The next few paragraphs explain brie
how the sample operating statement is
up.

Sales in the locker and freezer pr
visioning industry fall into two disti

ssifications -- sale of services and e of merchandise. The LFP uniform ounting system is tailored to provide ningful information on these two ssifications.

e of Services

Services also are divided into two ups -- storage and processing. Storage sists of annual and short-term locker als, and commercial or bulk storage. cessing services include custom processing for patrons, and processing plant-ed products for sale.

In the latter situation, the cost of essing plant-owned food products is sferred at the end of the accounting od from the processing department to department handling the sale of the uct. This procedure, called an inter-rtmental transfer, is described in detail e section "Using the LFP System."

of Merchandise

Merchandise sales are classified as s of meats, frozen foods, and other chandise.

The heading "Meats" includes beef, pork, lamb, poultry, and specialty products. Whenever these products been prepared in any way by the essing department, the cost or esti-d cost of direct processing labor and lies is charged to the meat sales de-ment as part of the cost of goods sold.

"Frozen foods" includes frozen pack-foods; bulk fruits (such as 30-pound tins of cherries or strawberries); and frozen foods purchased from outside sources, refrigerated, and sold to customers.

"Other Merchandise" consists of freezers, freezing supplies, and other merchandise that cannot be classed as meats or frozen foods. Firms selling freezers should handle them in a special account, as shown in the expansion chart.

End Results

A monthly operating statement similar to the accompanying one can be prepared by a locker and freezer provisioner who adopts the LFP system. It uses the two basic classifications of sales described in the preceding section -- service and merchandise. Following the sales figure is the cost of sales; beneath that, gross margins. Up to this point the statement has been departmentalized so that gross margins can be calculated for each major activity.

Operating expenses are not departmentalized in the same manner. They are classified into plant, selling and delivery, and general and administrative expense.

The balance sheet, which follows the operating statement, is typical of most such statements found in accounting systems. It is given to assist locker and freezer provisioners in preparing statements of their own. It needs no special explanation here.

Typical Monthly

OPERATING STATEMENT

Using the LFP Uniform System of Accounting
NOTE - Figures used here are fictitious - For illustration only

Acct. No. or class.[1]		TOTALS		SERVICES Storage 401	SERVICES Pro'ss'g 402	MERCHANDISE Meats 404	MERCHANDISE Frozen Foods 405	MERCHANDISE Othe 406
(400)	Sales	$12,900.00 -	100.0%	$1,050.00	$2,100.00	$6,125.00	$2,700.00	$925.
	Cost of Sales							
(502-a)	Direct labor-processing				1,078.00			
(502-b)	Processing supplies used				410.00			
					1,488.00			
(502-c)	Inter-dept. transfer				(428.00)	428.00		
	Cost of mdse. sold					4,595.00	2,180.00	525.
(500)	Total cost of sales	8,788.00 -	68.1%	-	1,060.00	5,023.00	2,180.00	525.
	Gross Margins	4,112.00		1,050.00	1,040.00	1,102.00	520.00	400.
	%-Margins to net sales		31.9%	100.0%	49.5%	18.0%	19.3%	4
(10)	Operating Expense							
	Plant	1,023.00 -	7.9%					
	Selling and delivery	1,222.00 -	9.5%					
	General and administrative	1,262.00 -	9.8%					
	Total operating exp.	3,507.00 -	27.2%					
	Operating Profit	605.00 -	4.7%					
(700)	Add: Other income	207.00						
(800)	Deduct: Other outgo	228.00						
		(21.00)						
	Net Profit - before taxes	$584.00						

Sales	100.0%
Cost of sales	68.1%
Operating expense	27.2%
Operating profit	4.7%
	100.0%

[1]Numbers ending in zero identify classifications of accounts. Other numbers identify specific accounts.

OPERATING EXPENSE		
Plant		
Indirect labor	$130.00	
Plant supplies	50.00	
Power, light, heat and water	300.00	
Repairs - maintenance	110.00	
Rent	130.00	
Laundry	32.00	
Depreciation - building and equipment	210.00	
Taxes - real estate, etc.	61.00	
		$1,023.00
Selling and Delivery		
Wages, salaries, commissions	600.00	
Advertising - promotion	237.00	
Truck (delivery) expense	215.00	
Depreciation - truck(s), auto	170.00	
		1,222.00
General - Administrative		
Salaries - off./part./prop.	500.00	
Salaries - office	275.00	
Office supplies, postage	78.00	
Insurance - other than life	108.00	
Dues and subscriptions	15.00	
Telegraph and telephone	42.00	
Bad debt expense	64.00	
Donations	10.00	
Travel and entertainment	70.00	
Payroll taxes	46.00	
Other taxes and licenses	17.00	
Legal and prof. fees	25.00	
Depreciation - office equipment		
Miscellaneous	12.00	1,262.00
Total operating expense		3,507.00
OTHER INCOME		
Discounts earned	-	
Interest and earnings - financing	118.00	
Bad debts recovered	109.00	
Cash - over and short	(20.00)	207.00
OTHER OUTGO		
Discounts (cash) allowed	-	
Interest expense	116.00	
Life insurance expense	112.00	228.00

TYPICAL BALANCE SHEET

Using the LFP Uniform System of Accounting

Note - Figures used here are fictitious - for illustration only

ASSETS

Account Number				
	Current Assets			
101	Cash - in office		$300.00	
102				
103	In bank(s)		6,702.00	$7,002.
104				
111	Notes receivable - due from customers		786.00	
112				
113	Accounts receivable - due from customers		8,435.00	
114	Accounts receivable - due from officers/employees		346.00	
115	Bank - financing reserve		387.00	
116			9,954.00	
251	Less: Allowance for doubtful accounts		962.00	8,992.
	Inventories			
131	Meats and poultry - for resale		398.00	
132	Frozen foods - for resale		2,964.00	
133	Freezers - for resale		2,796.00	
134	Freezing supplies - for resale		798.00	
135	Processing supplies		485.00	
136				
137				7,441.
	Total current assets			23,435.
	Investments			
141	U. S. bonds		750.00	
142	Cash surrender value - life insurance		1,079.00	
143				1,829.
	Prepaid			
161	Interest		78.00	
162	Taxes		167.00	
163	Insurance		375.00	
164				620.
	Fixed - Property and Equipment			
171	Land		4,800.00	
172	Building	$18,650.00		
253	Less: Allowance for depreciation	6,520.00	12,130.00	
173	Plant equipment	10,555.00		
253	Less: Allowance for depreciation	4,250.00	6,305.00	
174	Truck(s) - automobile(s)	4,875.00		
253	Less: Allowance for depreciation	2,860.00	2,015.00	
175	Office equipment	650.00		
253	Less: Allowance for depreciation	250.00	400.00	25,650.
	Total assets			$51,534.

TYPICAL BALANCE SHEET - Cont.

LIABILITIES

ount ber			
	Current Liabilities		
1	Accounts payable - trade	$1,876.00	
2			
3	Notes payable - trade	1,793.40	
4			
5	Notes payable - bank(s)	5,000.00	
1	Accrued interest payable	86.00	
2	Accrued salaries and commissions	74.00	
3	Accrued payroll withholdings	127.00	
4			
5			
6	Accrued sales taxes payable	204.00	
	Total current liabilities		$9,160.40
	Long Term		
1	Mortgage payable		3,500.00

NET WORTH

Proprietors capital account	35,000.00	
Proprietors drawing account	(1,700.00)	
Profit and loss account	4,989.60	
Profit and loss - current period	584.00	38,873.60
Total liabilities and net worth		$51,534.00

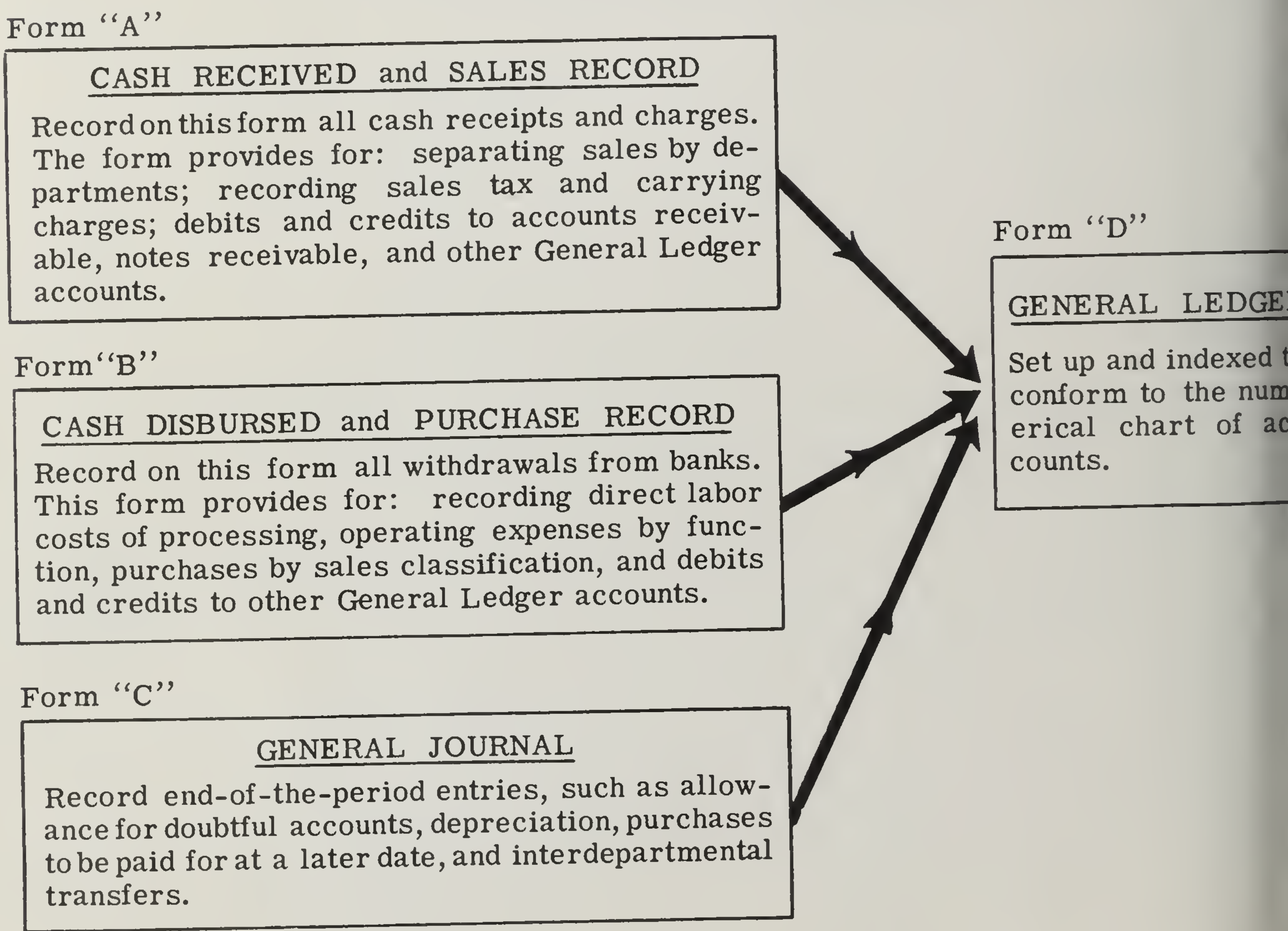
General Description of System

The heart of the LFP system lies in four basic accounting forms, which are designated in this Guide as "A," "B," "C," and "D." They are described briefly here and are discussed in detail and illustrated in the section "Four Basic Accounting Forms."

Form "A" is used to record all cash received and all sales. This information comes from sales tickets, order forms, and similar records. Form "B" is a record of cash disbursed and purchases. These figures come from records of payments, such as check books, and from i voices for purchases. Form "C," t General Journal, is provided for end-o the-period entries, such as depreciati and allowance for doubtful accounts.

At the end of the accounting period usually the end of each month -- informati from Forms "A" and "B" is summariz and posted to Form "D," the Gener Ledger. The accounting information fro Form "C," the General Journal, also posted to the General Ledger at the end the month.

Flow of Accounting Information



This chart illustrates how accounting information flows through the system. It al shows the relationship between Form "D," the General Ledger, and the other thr forms.

Identification of Accounts

In the LFP system, accounts are classified by numbers instead of names. Numbers are used because it is easier to memorize them and much easier to insert them in worksheets and forms.

Basic Classification of Accounts

Here is the basic classification of accounts. Similar accounts are grouped together to assist operators in remembering them. For example, the 400 group designates sales and service income, while the group numbered below 100 designates operating expenses.

RATING EXPENSES in the General Ledger are numbered from .... 10 to 99

ET accounts in the General Ledger are numbered from .... 100 to 199

BILITY accounts in the General Ledger are numbered from .... 200 to 299

WORTH accounts in the General Ledger are numbered from .... 300 to 399

ES accounts in the General Ledger are numbered from .... 400 to 499

T OF SALES accounts in the General Ledger are numbered from ..... 500 to 599

ER INCOME accounts in the General Ledger are numbered from ..... 700 to 799

ER OUTGO accounts in the General Ledger are numbered from ...... 800 to 899

Numerical Chart of Accounts

This detailed numerical chart covers the accounts most locker and freezer provisioners will need. There are unassigned numbers in the chart to take care of an accounts that might be required for operations peculiar to a particular business It is best, however, to keep such extr accounts to a minimum.

NUMERICAL CHART OF ACCOUNTS

SALES

Account Number	
401	Storage
402	Processing
403	
404	Sales - Meats
405	Sales - Frozen Foods
406	Sales - Other Merchandise

COST OF SALES

Account Number	
501	
502-a	Direct Labor - Processing
502-b	Processing Supplies Used
502-c	Direct Cost Charged to Plant Owned Products
503	
504	Cost of Meat Sold
505	Cost of Frozen Foods Sold
506	Cost of Other Merchandise Sold

OTHER INCOME

701	Discounts Earned
702	
703	Interest and Earnings - Financing
704	Bad Debts Recovered
705	Gain or Loss on Sale of Fixed Assets
706	Cash Over and Short
707	
708	

OTHER OUTGO

801	Discounts (Cash) Allowed
802	Interest Expense
803	
804	Life Insurance Expense
805	
806	
807	
808	

OPERATING EXPENSE

unt ber	Plant
	Indirect Labor
	Plant supplies
	Utilities - Power, Light, Heat, and Water
	Repairs and Maintenance
	Rent
	Laundry
	Depreciation - Building and Equipment
	Taxes - Real Estate, etc.

	Selling and Delivery
	Wages, Salaries, Commissions
	Advertising and Promotion
	Delivery Truck Expense
	Depreciation - Truck and Automobile

Account Number	General and Administrative
51	Salaries - Officers/Proprietors/ Partners
52	Salaries - Office
53	
54	Office Supplies and Postage
55	Insurance
56	Dues and Subscriptions
57	
58	Telephone and Telegraph
59	Bad Debt Expense
61	Donations
62	Travel and Entertainment
63	Payroll Taxes
64	Other Taxes and Licenses
65	Legal and Professional Fees
66	Depreciation - Office Equipment
67	Miscellaneous Expense
68	
69	

Account Number	ASSETS
101	Cash - In Office
102	
103	Cash - In Bank(s)
104	
111	Notes - Due from Customers
112	
113	Accounts - Due from Customers
114	Accounts - Due from Officers and Employees
115	Bank - Financing Reserve
116	
131	Inventory - Meats and Poultry - For Resale
132	Inventory - Frozen Foods - For Resale
133	Inventory - Freezers - For Resale
134	Inventory - Freezing Supplies - For Resale
135	Inventory - Processing Supplies
136	
137	
141	U.S. Bonds
142	Cash Surrender Value-Life Insurance
143	

Account Number	ASSETS (Continued)
161	Prepaid Interest
162	Prepaid Taxes
163	Prepaid Insurance
164	
171	Land
172	Building
173	Plant Equipment
174	Truck(s) and Automobile(s)
175	Office Equipment
176	
177	
	LIABILITIES
201	Accounts Payable - Trade
202	
203	Notes Payable - Trade
204	
205	Notes Payable - Bank(s)
206	
221	Accrued Interest Payable
222	Accrued Salaries and Commissions
223	Accrued Payroll and Withholdin Taxes
224	

ount nber	LIABILITIES (Continued)
25	
26	Accrued Sales Taxes
27	
41	Mortgage Payable
51	Allowance for Doubtful Accounts
52	
53	Allowance for Depreciation
54	

Account Number	NET WORTH
311	Proprietors/Partners - Capital Account
312	
313	Proprietors/Partners - Drawing Account
314	
351	Profit and Loss

ansion Chart

The sales accounts common to most rations are Storage (401), Processing), Sales-Meats (404), Sales-Frozen ds (405), and Sales-Other Merchandise). These five accounts form the basic sification of income or sales for the uniform system.

However, many operators will need e detailed sales information than would rovided by just these five accounts. following Expansion Chart illustrates basic accounts can be expanded. For mple, account 402 is Processing. Operators desiring more detail should not set up a single account for Processing (402). Instead they should use accounts such as those listed on the right-hand side of the chart: Slaughtering, (402-1); Meat Processing, (402-2); and Curing and Smoking (402-3).

It is not necessary to expand all the basic income accounts just because one is expanded. An operator may choose to break down processing into the seven accounts shown for this type of income but still have only one account, Storage (401), for locker rentals, bulk storage, and other storage income.

EXPANSION CHART

BASIC OPERATIONS	EXPANSION CHART for further breakdown of basic operations

- (400) ALL SALES
  - (401) STORAGE
    - 401-1 Locker Rentals - Annual
    - 401-2 Locker Rentals - Short Term
    - 401-3 Zero Bulk Storage
    - 401-4 All Other Storage
  - (402) PROCESSING
    - 402-1 Slaughtering
    - 402-2 Meat Processing (Chill, Age, Cut, Slice, Grind, Wrap, Freeze)
    - 402-3 Curing and Smoking
    - 402-4 Rendering
    - 402-5 Poultry Dressing
    - 402-6 Sales of Inedibles, Hides, etc.
    - 402-7 Fruit and Vegetable Processing
    - 402-8
  - (403)
  - (404) MEATS
    - 404-1 Beef
    - 404-2 Veal
    - 404-3 Pork
    - 404-4 Lamb
    - 404-5 Poultry
    - 404-6
  - (405) FROZEN FOODS
    - 405-1
    - 405-2
    - 405-3
  - (406) OTHER MERCHANDISE
    - 406-1 Freezers
    - 406-2 Freezing Supplies
    - 406-3
  - (407)

Four Basic Accounting Forms

This section of the Guide describes four basic accounting forms used in the ? uniform accounting system.

Form "A," Cash Received and Sales ord, and Form "B," Cash Disbursed Purchase Record, were designed ecially for this system. Form "C," eral Journal, and Form "D," General ger, are similar to forms used in rly every accounting system.

The General Ledger, Form "D," differs hat it provides columns for depart-talizing or allocating income and ex-ses. For example, a ledger sheet can et up for Processing (402). The detail mns on this sheet can be used to show breakdown of processing revenue into ghtering (402-1), Meat Processing -2), and Curing and Smoking (402-3).

<u>n "A" - Cash Received Sales Record</u>

This form, with sample entries, shows to record cash received and sales. All receipts and all charge sales are red on this form. The accounting data es from sales tickets, processing ts, receipts for payments on accounts, register tapes, and other records of received and charges. Information this form is summarized and posted e General Ledger, Form "D."

The left side of the form is self-bal-ng, as shown on the sample. It pro-s all the accounting data necessary to rd cash received and sales. Alone, ver, it does not provide the detailed s information necessary for the man-ent of most firms. This is the func-of the right side of the form.

One column is provided on the left for recording "All Sales Income." right side provides 14 columns for breaking down this sales income into as many classifications as desired. Thus the total from all columns on the right side must equal the total of the "All Sales Income" column on the left side.

In posting information from Form "A" to the General Ledger, the total of the "All Sales Income" column on the left side is not used. Instead, the information on the right side of the form showing the detailed breakdown is posted. More detailed discussion of this is found in the section titled "Posting to the General Ledger."

The following are brief descriptions of typical entries on Form "A." For easy reference, each item is numbered.

Line one - Total brought forward from previous sheet.

Items 1, 2, and 5 - Cash received as payment on account.

Item 3 - Charge sales of meats, frozen food, and a freezer.

Items 4 and 12 - Sales of merchandise. In both, a note was given as security for payment. The amount of each note includes the cost of the merchandise purchased and the sales tax. One also includes finance charges.

Item 6 - Cash sale of meats, frozen foods, and locker rental.

Items 7 and 13 - Summary of cash register receipts showing sale of custom processing services, meats, frozen foods, and other merchandise.

Item 8 - Owner of firm puts $500 into the business.

Item 9 - Cash received on a bill previously written off the books as uncollectible.

Item 10 - Bank loan of $1,000. Interest amounting to $30 was withheld by the

bank and $970 was deposited to the firm's account.

Form "B" - Cash Disbursed and Purchase Record

The sample Form "B" illustrates the method of handling cash disbursements and purchases. All cash disbursed and all purchases not paid for at the end of the month should be entered on this form. The accounting data comes from check stubs, disbursement vouchers, or other records of cash disbursed, and from invoices of merchandise received but not yet paid for.

The total of all debits will equal the total of all credits on the left side of the form, as shown in the illustration. This provides all the accounting information necessary for recording cash disbursements and purchases. It does not provide, however, as much detail as most operators need. The right side of Form "B" is designed for this purpose.

One column is provided on the left side for all operating expenses, and another column for recording all merchandise purchases. The right side of the form provides 13 columns for breaking down these 2 types of expenditures into as many classifications as desired. Thus the total of all figures shown in columns on the right side must equal the total of the Operating Expenses and Merchandise Purchases on the left side. In posting information from this form, these totals are not used. Instead, the detailed breakdown of Operating Expenses and Merchandise Purchases shown on the right side is posted.

The following are brief description of typical entries on Form "B."

Items 1 through 6 - Payroll, including withdrawal by proprietor.

Items 7, 8, and 13 - Paid for merchandise purchased.

Items 9, 10, and 11 - Paid for various monthly operating expenses.

Item 12 - Paid payroll withholding tax to Collector of Internal Revenue.

Item 14 - Purchased equipment.

Item 15 - Paid $500 on bank loan.

Items 16 through 20 - Reimbursed petty cash.

Item 21 - Entered unpaid invoice for merchandise purchased. (End-of-month entry.)

Form "C" - General Journal

Form "C" is used for entries that cannot readily be made on Forms "A" or "B." Entries that would normally be made on Form "C" include the monthly charge for depreciation, bad debts, interdepartmental transfers for processing plant-owned products, and cost of goods sold during the month. If the entry to set up accounts payable for merchandise purchased but not paid for during the month is not made on Form "B," it should be recorded here (see illustrative entry 4).

This form provides two columns in addition to the debit and credit columns. One is headed "Source" and the other "Detail." The "Source" column may be used to show authority for an entry or source of information supporting an entry. For example, if an entry affecting a partner's capital or drawing account needs to be initialled by that partner, the "Source" column can be used for this purpose. Other entries are based on information contained in memoranda, tabulations, or worksheets. The "Source" column should be used to identify these.

The "Detail" column is useful when writing off bad debts or making similar entries. For example, in writing off a number of uncollectible accounts, the total is debited to (251) Allowance for Doubtful

ounts and credited to (113) Accounts - from Customers. The "Detail" column sed to show the amounts of the indi- al accounts being written off which is posted to the accounts receivable er.

n "D" - General Ledger

Form "D" is a sample General Ledger . In addition to the columns usually d on a general ledger sheet, a number hers are provided for recording more detailed information. For example, one account can be used for recording all processing labor, with the detail columns used for a breakdown into such classifications as slaughter, meat processing, and curing labor.

The column headed "Balance" is used to record the cumulative balance in the account. The column headed "Month" is used to show the total for each month and is particularly useful when a number of entries are made for the same account each month.

511802 O - 59 (Face blank p. 18) No. 1

FORM "A"

CASH RECEIVED AND SALES RE

CASH RECEIVED & SALES RECORD

MONTH OF *January 1959*

ITEM	DATE	SOURCE	SALES TICKET NO.	ALL CASH RECEIVED DR-103		SALES TAX CR-226	ALL SALES INCOME	ACCOUNTS RECEIVABLE DEBITS	ACCOUNTS RECEIVABLE CREDITS	√	NOTES RECEIVABLE DEBITS	NOTES RECEIVABLE CREDITS	GENERAL LEDGER DEBITS	GENERAL LEDGER CREDITS	ACCT. NO.	ITEM
				10,610.78		280.48	11,998.32	12,007.12	12,305.90		1,640.00	289.50	1,472.40	856.10		
1	30	John A. Jones	398	42.50					42.50	✓						1
2		Harry T. Smith	399	28.30					28.30	✓						2
3		L.T. Holmes-Food Plan	400			7.73	378.77	386.50		✓						3
4		R.J. London	401			3.45	115.04			✓	123.29			4.80	703	4
5		Susan North	402	33.80					33.80	✓						5
6		County Hotel	403	76.76		2.28	74.48									6
7		Cash Register	404	60.90		1.20	59.70									7
8	31	F.L. Owner	405	500.00										500.00	311	8
9		Ace Collection Agency (H.T. Walker)	406	18.75										18.75	704	9
10		First National Bank	407	970.00									30.00		161	10
11														1,000.00	205	11
12		Alice Smith	408			5.88	195.91			✓	209.79			8.00	703	12
13		Cash Register	409	80.25		2.47	77.78									13
14																14
15				12,422.04		303.49	12,900.00	12,393.62	12,410.50		1,973.08	289.50	1,502.40	2,387.65		15

Post to General Ledger

Account Number		Debits	Credits		Account Number
(103)	Bank-Cash Received	$12,422.04	$303.49	Accrued Sales Tax	(226)
(113)	Accounts Receivable	12,393.62	12,410.50	Accounts Receivable	(113)
(111)	Notes Receivable	1,973.08	289.50	Notes Receivable	(111)
(various)	General Ledger	1,502.40	2,387.65	General Ledger	(various)
			12,900.00	All Sales Income	Post breakdown of sales to appropriate account -- see opposite page
		28,291.14	28,291.14		

CASH RECEIVED & SALES RECORD

MONTH OF *January 1959*

ITEM	CREDITS – ALL SALES INCOMES – CREDITS: STORAGE 401	PROCESSING 402	MEATS 404	FROZEN FOODS 405	OTHER MDSE. 406	ITEM
	1038.00	2087.00	5731.84	2541.13	600.35	
1						1
2						2
3			58.00	20.77	300.00	3
4			92.64	22.40		4
5						5
6	12.00		40.48	22.00		6
7		6.00	28.00	14.00	11.70	7
8						8
9						9
10						10
11						11
12			142.04	49.70	4.17	12
13		7.00	32.00	30.00	8.78	13
14						14
15	1050.00	2100.00	6125.00	2700.00	925.00	15

Post to General Ledger - Credits only

$1,050.00	Income - Storage	(401)			
2,100.00	Income - Processing	(402)			
6,125.00	Income - Sale of Meats	(404)			
2,700.00	Income - Sale of Frozen Foods	(405)			
925.00	Income - Sales of Other Merchandise	(406)	or (406-1)	Freezers	$600.00
			(406-2)	Freezing Supplies	325.00
12,900.00	Total Income - All Sales				925.00

511802 O - 59 (Face blank p. 18) No. 3

FORM "B"

CASH DISBURSED AND PURCHASE RE

CASH DISBURSED & PURCHASE RECORD

MONTH OF *January 1959*

ITEM	DATE	PAID TO, OR, PURCHASED FROM	CHECK NO. OR JNL. ENTRY	CASH PAID CR-103	PAYROLL WITH'LDGS. CR-223	ENTER DIRECT LABOR. PRSS'ING.	ENTER ALL OPERATING EXPENSE	ACCT. NO.	ENTER ALL MDSE. PURCHASES	GENERAL LEDGER DEBITS	GENERAL LEDGER CREDITS	ACCT. NO.	ITEM
				10388 65	247 00	933 00	2287 10		6138 00	1876 00	598 45		
1	30	Robert White - Payroll	343	66 98	13 02	80 00		502-a					1
2		Al Brown "	344	55 28	9 72	65 00		502-a					2
3		Susan Ward "	345	63 08	6 92		70 00	52					3
4		Joseph Jones "	346	62 48	12 52		75 00	31					4
5		John Sawyer "	347	66 98	13 02		80 00	31					5
6		F.L. Owner-Prop. "	348	84 30	15 70		100 00	51					6
7		Arcadia Packing Co.	349	187 90				131	187 90				7
8		Ace Frozen Food Co.	350	170 00				132	170 00				8
9		General Accounting Co.	351	90 00			90 00	65					9
10		Black Electric Co.	352	32 70			32 70	15					10
11		State Power & Light Co.	353	320 00			320 00	14					11
12		Director Internal Revenue	354	287 90						287 90		223	12
13		A.B. Seasoning Co.	355	39 27				135	39 27				13
14		R & A Motor Co.	356	74 72						74 72		174	14
15		First National Bank	357	500 00						500 00		205	15
16		Reimburse Petty Cash	358	88 40			18 75	35					16
17		"					32 00	32					17
18		"					7 20	15					18
19		"					5 45	35					19
20		"					25 00	54					20
21		Jackson Poultry Co.	Jnl. Ety					131	116 50		116 50	201	21
22				12578 64	317 90	1078 00	3143 20		6651 67	2738 62	714 95		22

Post to General Ledger

Acct.		Debits	Credits		Acct.
(502-a)	Direct Labor - Processing	$1,078.00	$12,578.64	Cash Paid	(103)
			317.90	Payroll Withholding	(223)
Do not post. Instead post detail on opposite page			714.95	General Ledger	(various)
	Operating Expenses	3,143.20			
	Purchases - Inventory	6,651.67			
(various)	General Ledger	2,738.62			
		13,611.49	13,611.49		

CASH DISBURSED & PURCHASE RECORD

MONTH OF January 1959

ITEM	ACCT. NO.	DEBIT OPERATING EXPENSE PLANT OPERATING	SELLING-DELIVERY	DEBIT GENERAL ADM'S'TIVE.	ACCT. NO.	DEBIT MERCHANDISE PURCHASES MEATS	PROCESSING SUPPLIES	FROZEN FOODS	DEBIT OTHER 133	ACCT. NO.
		584 30	885 80	817 00		4667 60	280 73	502 00	687 67	
1										
2										
3				70 00	52					
4	31		75 00							
5	31		80 00							
6				100 00	51					
7						187 90				
8								170 00		
9				90 00	65					
10	15	32 70								
11	14	320 00								
12										
13							39 27			
14										
15										
16	35		18 75							
17	32		32 00							
18	15	7 20								
19	35		5 45							
20				25 00	54					
21						116 50				
22		944 20	1097 00	1102 00		4972 00	320 00	672 00	687 67	
23										
24										

Operating Expenses

Summarize by acct. no. and post to General Ledger

Plant Operating	Selling and Delivery	General and Admin.
Accounts 11 through 29	Accounts 31 through 49	Accounts 51 through 69
$944.20	$1,097.00	$1,102.00

Total operating expense $3,143.20

Merchandise Purchases

Post to Inventory Accts. in General Ledger

Acct.		
(131)	Meats	$4,972.00
(132)	Frozen Foods	672.00
(133)	Freezers	687.67
(135)	Processing Supplies	320.00
	Total	6,651.67

FORM "C"

GENERAL JOURNAL

GENERAL JOURNAL

MONTH OF January 1959

DAY	DESCRIPTION OF ENTRIES — DEBIT	DESCRIPTION OF ENTRIES — CREDIT	SOURCE	DETAIL	ACCOUNT NUMBER	GENERAL LEDGER DEBIT	√	GENERAL LEDGER CREDIT
1-31	Depreciation - Building and Equipment				19	210 00		
	Depreciation - Truck and Auto				36	170 00		
	Depreciation - Office Equipment				66	59 00		
		Allowance for Depreciation			253			439 00
	To set up depreciation expense for Month of January							
1-31	Bad Debt Expense				67	64 00		
		Allowance for Doubtful Accounts			251			64 00
	To set up bad debt expense for month of January							
1-31	Cost of Meat Sold				504	428 00		
		Direct Expense charged to Plant owned Product			502-C			428 00
	To Charge the direct expense (processing labor and supplies) incurred in processing plant owned meat to cost of meat sold. (See pages — to — for an explanation of how to compute the amount of the charge.)							
1-31	Inventory - Frozen Foods				132	170 00		
		Accounts Payable - Zero Frozen Food Co.			201			170 00
	To set up accounts payable for purchases made in January which will be paid later (See Form B, Item 21 for alternative method of recording accounts payable.)							

See pages 34 to 37 for an explanation of how to compute the amount of the charge.

FORM "D"
GENERAL LEDGER

GENERAL LEDGER

ACCOUNT NO. 402

NAME OF ACCOUNT Processing

DETAIL														
					Slaughtering 402-1	Meat Processing 402-2	Cure and Smoke 402-3	Rendering 402-4	DATE 1959	REF.	DEBITS	CREDITS	BALANCE	DR. OR CR.	MONTH
					450 00	1100 00	500 00	50 00	1-31	A		2100 00	2100 00		
					425 00	1050 00	400 00	25 00	2-28	A		1900 00	4000 00		
					430 00	1150 00	450 00	20 00	3-31	A		2050 00	6050 00		

mportance of Sales Tickets

ost firms use sales tickets to record of processing services, locker s, and sales of merchandise. Sales s are original records and provide a part of the information needed for ting the LFP system. They should eserved.

nere are many kinds of sales tickets. re prepared in duplicate or triplicate, ding on the needs of the firm. Gen- the first copy is the accounting or copy and the second is for the cus- . If there is a third, it is the work or processing copy.

les tickets vary greatly in size, de- and complexity. Some firms use e forms containing a minimum of inting but providing space for writing e basic information on customer ty, type of transaction, and descrip- of service or product sold. Large ex forms, used by many freezer sioners, not only combine the functions of order form, sales ticket, and processing ticket, but also have pre-printed headings and stubs covering all the products and services the firm offers.

All sales tickets should be numbered consecutively and all numbers accounted for. On charge sales, the number of the ticket may be noted on the customer's account sheet for future reference.

When a sales ticket is entered on the Cash Received and Sales Record (Form "A"), care should be taken to separate such an item as sales tax from the actual sales value. See entry on line 6 of the illustrated Form "A."

Some operators require a ticket for every sale -- cash or charge. Others use tickets only for charge sales, and analyze cash sales by means of a cash register. Whichever procedure is used, care should be taken to insure that sales can be properly departmentalized and that other charges, such as sales tax and carrying charges, are properly recorded.

Using the LFP System

is section of the Guide explains how the LFP Uniform Accounting System. ctions for preparing an operating nent are given first; then instructions alance sheet accounts; and finally, ctions concerning posting, and pre- a trial balance.

discussing individual accounts, both mber and title as shown in the Num- Chart of Accounts are given. This it easier to refer to the sample and statements included in the Guide.

erating Statement Accounts

ocker and freezer provisioners will at they can manage their businesses more efficiently when operating statements are available to them monthly. The LFP system is designed so that a bookkeeper can prepare an operating statement readily and have it in the hands of management shortly after the end of each month.

Generally, balance sheets are not prepared monthly. Most locker and freezer provisioners find that an annual or semi-annual balance sheet meets their needs.

Accounts affecting the operating statement and the accounting procedures involved are discussed in the Guide in this order: (1) Sales; (2) cost of sales; (3) gross margins; (4) operating expenses -- plant, selling and delivery, and general and administrative; and (5) other income -- other outgo.

Sales

The sales figure shown in the typical operating statement both in total and by departments is important to accounting records. It is one yardstick for measuring results of operations. Every other figure in the statement -- such as cost of sales, gross margins, operating expense, and operating profit -- can be uniformly related to and expressed as a percentage of sales.

Bookkeepers should be careful not to confuse "billings" with sales and thus include such items as sales taxes and carrying charges.

The number of sales or revenue accounts selected will depend upon the number of different functions the business performs and the needs of the operator. The Expansion Chart, page 14, should be used as a guide in setting up these accounts. Only accounts necessary for managing the business should be set up, because each one added tends to increase the job of taking inventory, allocating labor, and performing similar administrative and bookkeeping tasks.

Storage Revenue

Storage revenue comes from annual and short-term locker rentals and from bulk zero and other refrigerated storage.

Most firms consider revenue from these activities as belonging to the period the storage service was sold, even though deferred income frequently is involved, as in the case of annual locker rentals. The LFP Uniform System conforms to this generally accepted industry practice.

In constructing a monthly operating statement, however, the unearned portion of annual locker rental revenue is excluded from that month's storage revenue. To accomplish this, multiply the number of lockers rented on an annual basis by one-twelfth of the average locker-rental rate. To this figure add all revenue received during the month for short-term locker rentals, bulk storage, and other refrigerated storage. This will produce a substantially accurate total of storage revenue for the month and will avoid including unearned locker rental revenue.

Some operators may wish to keep a detailed record of deferred locker rentals. A method for doing this is described later in the Guide in the section, "Deferred Locker Rental Revenue."

Cost of Sales

The LFP system provides a method for determining cost of sales so that gross margins can be calculated for each department. This information is used in preparing an operating statement (see sample).

Three types of expenses are included in cost of sales. They are:

1. Direct processing labor.

2. Processing supplies used.

3. Purchase cost of merchandise sold.

In this system, all direct labor and all supplies used in processing are recorded as a cost to the processing department. In firms that do custom processing and also process plant-owned products, part of these costs are then charged against the products being processed for sale. This is done through an interdepartmental transfer of costs from the processing department to the department credited with the sale of the product. This transfer of costs is illustrated on the typical operating statement. The accounting procedure involved is discussed under "Interdepartmental Transfers."

Freezer provisioning firms that do no custom processing have no reason to use

interdepartmental transfer procedures; r direct cost of processing applies to plant-owned products. The operg statement for this type of firm would w no processing income. The direct of processing would be shown in Cost of Sales section for the dements credited with the sale of the lucts.

Cost of sales is discussed by departts in the following sections.

age Department

As shown in the typical operating statet, there is no cost of sales in the age department. Ordinarily, this dement uses little or no direct labor or lies. Labor used to transfer frozen from freezer to locker or to handle en food for eventual home freezer age can rightfully be called part of processing function and charged to that rtment. Labor used to assemble en food orders should be charged to ng and delivery.

About the only labor used in the storage rtment is for defrosting coils, clean- storage rooms, and repairing and taining lockers and other equipment. is not shown as direct labor in the age department but as Indirect Labor a plant operating expense account.

cessing Department

The processing department is the manuring or production branch of the busi-. It serves customers and also serves r departments. The typical operating ement shows the two types of direct s in the processing department. These Direct Labor - Processing (502-a) and cessing Supplies Used (502-b).

502-a) Direct Labor - Processing - In LFP system labor is classified as: ct labor - processing; indirect labor - t; selling and delivery labor; and gen- and administrative labor.

Only direct labor - processing is included as an item in cost of sales. Processing labor can be subdivided according to function, such as slaughter, meat processing, and curing labor. Procedures for determining direct labor costs for processing are discussed in the section "Labor Allocation."

(502-b) Processing Supplies Used - Processing supplies include items needed for wrapping and packaging, curing and seasoning materials, shrouds, small processing tools, and similar supplies. These should not be confused with Plant Supplies (13) or Office Supplies and Postage (54). Computing the cost of processing supplies involves proper recording of purchases and correct inventorying. These procedures are discussed next.

Cost of Merchandise Sold

In determining cost of merchandise sold, two accounting procedures must be considered. They concern method of handling purchases, and proper inventorying methods.

The typical balance sheet shows these five classifications under Inventories:

(131) Meats and Poultry - For Resale

(132) Frozen Foods - For Resale

(133) Freezers - For Resale

(134) Freezing Supplies - For Resale

(135) Processing Supplies

Note that inventory accounts 131 through 134 cover merchandise purchased for resale. Inventory account 135 covers supplies to be used in the processing department and not for resale. Meat and poultry purchased and debited to account (131) Meat and Poultry - For Resale frequently take on added value because they are processed before being sold by the meat department. Merchandise in accounts 132, 133, and 134

is usually sold "as is" and thus takes on no added value.

Form "B," Cash Disbursed and Purchase Record, illustrates the handling of purchases to the inventory accounts. The column on the left side headed "Enter All Mdse. Purchases" shows the total of all such purchases and serves as a control column. The purchases are then analyzed on the right-hand side of the form.

All the purchases shown on Form "B" are recorded in the inventory accounts. These debits to inventory increase the dollar value of the assets. As inventories are sold or used, the amount on hand decreases. These decreases in value are recorded by taking out of inventory the cost value of the merchandise sold or used during the same period. This is done by journal entry in the General Journal, Form "C," at the end of the period, decreasing (crediting) the inventory accounts and charging (debiting) this amount to the proper cost of sales account (See accounts in the 500 group in the Numerical Chart of Accounts).

<u>Frequency of Inventories</u> - It is essential that inventories be taken at the end of each accounting period to determine accurately the cost of merchandise sold or supplies used. If monthly operating statements are prepared then inventories must be taken monthly.

The most accurate method of inventorying is an actual physical count of all merchandise and supplies on hand. Some operators maintain running inventories by setting up a card or sheet for each item. Purchases are added and merchandise sold or used is deducted, so that a running record is kept of merchandise on hand. The running inventory record is verified from time to time by actual physical count of the merchandise.

Operators who cannot take a complete physical inventory each month may group their products into three or four categories and inventory one category the first month, another the following month, and so on In the months when no physical inventor of a category of products is taken, gros margin percentages, based upon previou experience, are used in determining in ventory. This method reduces the task o taking inventories yet provides for physical count of all products three o four times a year.

<u>Calculating Cost of Merchandise Sold</u> Proper procedure for calculating the cos of merchandise sold, using the froze food department as an illustration, is a follows:

Inventory of frozen foods at delivered cost at beginning of period	$2,900
Add: Purchases of frozen food - Form "B"	672
	3,572
Deduct: Inventory at end of the period	1,392
Cost of frozen food sold (see operating statement)	$2,180

<u>Interdepartmental Transfers</u>

Firms which do only custom processin deduct the cost of processing labor an supplies from custom processing revenue The resulting figure is the gross margi on custom processing.

Most firms, however, do other processing. They also process plant-owne products for sale. This makes it necessar to charge part of the direct processin costs to the product being processed fo sale by means of an interdepartmenta transfer.

In making this charge, the direct cos of labor and supplies for processing plant-owned products is transferred from th processing department and added to th cost of merchandise sold in the particula department that will sell the product. Thi is done with a journal entry debiting th cost of sales account benefiting from th processing and crediting the processin department. For example, if meat i processed for sale, the entry will show a debit to (504) Cost of Meat Sold and a credit to (502-c) Direct Cost Charged t Plant Owned Products.

The General Journal, Form "C," illus-
es an interdepartmental transfer entry.
typical operating statement also illus-
es how interdepartmental transfers
ct the cost of sales in various depart-
its.

Determining Transfer Costs - Inter-
artmental transfers should be at cost.
eral procedures that will accomplish
are described here. The operator can
ct the one that best suits his needs.

Firms in which plant-owned products
resent a rather minor portion of total
cessing volume may calculate the
unt to be transferred on a per pound
s. A number of tests can be made to
rmine the average cost per pound for
ct labor and processing supplies for
or processing activities. Each month
reful record is kept of the pounds of
t-owned products processed. At the
of the month the total cost can be
ulated and the interdepartmental
sfer of cost made.

Other procedures are more desirable
lume is large or if substantially dif-
nt techniques are involved in custom
essing and in processing plant-owned
lucts.

f processing costs and techniques for
t-owned products and custom process-
are similar, the direct cost of labor
supplies can be divided on the basis of
ds handled in each category. Inter-
rtmental transfer of costs can then
nade.

n plants where processing plant-owned
ucts differs substantially in labor and
ly requirements from custom proc-
ng, (i.e., manufacturing bologna) a still
rent procedure is required. In this
tion, direct labor costs for process-
lant-owned products may be calculated
r by multiplying hourly processing-
cost by hours spent in this work, or
eeping individual time sheets for em-
ees. Supply cost may be determined by maintaining a record of supplies used on plant-owned products or, if this is not possible, by estimating supplies used.

Labor Allocation

Labor expense frequently represents half the operating cost of a locker or freezer provisioning plant. Adequate records help control this cost.

The amount of detailed information needed on labor costs varies widely among plants, and the degree of accuracy necessary in allocating such labor by departments varies just as widely. Three procedures for allocating labor costs are described here. The operator can select the procedure that will give him the type of information he requires.

1. Allocating labor cost by primary function - Wages and salaries can be allocated to departments according to each employee's primary function. For example, if an employee is hired as a meat cutter, his total wages would be charged to processing even though he spent part of his time selling. In this setup, no part of the cost is charged to work done outside the major function on the assumption the employee would be necessary even if he did not perform the minor function. Therefore, since the employee must be paid anyway, any work he does outside his major function is "free."

2. Allocating labor cost by estimating labor usage - In this procedure, allocation of wages and salaries to departments is based upon an estimate of the time employees work in each. Time is allocated on the basis of expected work and is limited to each employee's two, or at most three, basic activities. Distribution of employees' salaries and wages among departments is not changed unless a major shift in operations occurs.

The owner-manager's salary is charged to "management," unless he regularly spends a substantial portion of his time in

Table 1. - *Estimated distribution of employees' time*

Employee	Direct labor-processing (502-a)	Selling and delivery (31)	Indirect labor-plant (11)	Office (52)	Managemen (51)
			Percent		
Employee A	75	15	10	-	-
Employee B	80	10	10	-	-
Employee C	-	20	-	80	-
Employee D	-	75	25	-	-
Owner-operator	-	-	-	-	100

processing or selling. In that case, a portion of his salary should be prorated to the other department.

Table 1 shows how a firm with five employees, including the owner-operator, can allocate employees' time by functions. The account to which each type of work would be charged also is shown.

These percentages are then used to allocate the payroll to appropriate functions (table 2).

A plant operator should take the following steps in applying this method to his own business:

Set up a form similar to table 1 to show estimated distribution of employees' time by functions. If the processing department (402) is divided into two or more departments, for example, slaughtering (402-1) and meat processing (402-2), then the column headed Direct labor-processing (502-a) in the time sheet should be eliminated and new columns established to sho direct labor for these functions. Th columns should be headed Direct labor slaughtering, and Direct labor - mea processing.

List all employees, including the owner operator, and estimate the percentage o time each will spend in each function o department. Past experience, plus a estimate of future business, should suffic in making the distribution. If an employe spends only a nominal amount of time in second or third function, make no allocation beyond the primary function.

Set up a form similar to table 2 to sho the allocation of payroll. List each employee and his weekly salary. Use th percentages showing distribution of th employees' time in allocating thei salaries to the various departments. Thi form will then contain the informatio necessary to record the payroll on Form "B" - Cash Disbursed and Purchase Record.

Table 2. - *Allocation of payroll, by functions*

Employee	Weekly salary	Direct labor-processing (502-a)	Selling and delivery (31)	Indirect labor-plant (11)	Office (52)	Managemen (51)
Employee A	$90.00	$67.50	$13.50	$9.00	-	-
Employee B	80.00	64.00	8.00	8.00	-	-
Employee C	75.00	-	15.00	-	$60.00	-
Employee D	70.00	-	52.50	17.50	-	-
Owner-operator	125.00	-	-	-	-	$125.00
	440.00	131.50	89.00	34.50	60.00	125.00

f the owner-operator regularly devotes gnificant portion of his time to other management functions part of his ry should be charged to the department hich he is working but at the going rate for that type of work. Take, for ple, an owner-operator who draws a week from the business and who s half-time in the processing depart-. If the weekly wage for an employee this type of work is $80, the owner-ator's salary would be allocated as vs:

irect labor - processing (502-a)	$40
laries - Off. Prop./Part. (51)	85
Total owner-operator's salary	$125

Allocating labor cost by time rec- - The third and most accurate method ocating labor costs among departments maintain a daily record of the time employee works in the various de-ients. This record is then used to bute or allocate salaries and wages. isfactory variation of this method is intain such a daily record for one out of each month and use the infor-n as a basis for distributing wages alaries during the entire month. A such as illustrated in table 2 can be for allocating each employee's salary. in turn provides the information for ding the payroll on Form "B."

weekly payroll record, similar to ccompanying one, can be used for ding time worked by employees by ons. This form can be mimeographed ept in a loose leaf notebook. A des-on of the activities falling into each on can be mimeographed on the back form.

Gross Margins

ross margins are calculated by sub-ng direct cost of sales from net These gross margin figures are important to management and should be provided quickly, both in total amount and as a percentage of sales, at the end of each month. Every month this information is delayed lessens its value.

The LFP system provides for determining gross margins by departments. These data are important because they show management how each department is contributing to the cost of operating the plant and the amount remaining after paying for direct labor and materials used. They also serve as a measure of operating efficiency. Changes in the gross margin percentages by department are a signal to management to investigate.

Gross margin data can be most useful when accounting is done uniformly over a period of time. This permits comparisons. Once basic departments have been established, expense accounts selected, and the method of allocating payroll determined, no changes should be made unless there is a basic change in operations, or an adjustment is necessary to improve the usefulness of the information.

Operating Expense

Operating expenses are numbered from 11 through 99 and grouped according to 3 distinct functions. They are classified as:

1. Plant expense

2. Selling and delivery expense

3. General and administrative expense

Many expenses such as those for labor, utilities, advertising, laundry, and rent are regularly paid at the end of each week or month. These present no problem in preparing monthly operating statements as the necessary information is readily available. (The one exception is labor when paid on a weekly basis. In this case, some operators may find it desirable to accrue

WEEKLY PAYROLL RECORD

Name of employee ______________________ For week ending ______________ 19____

Day of week		Time in	Time out	Total hours worked	Time in each function: Processing	Selling and delivery	Indirect labor-plant	Office	Management
	a.m.								
Monday	p.m.								
	a.m.								
Tuesday	p.m.								
	a.m.								
Wednesday	p.m.								
	a.m.								
Thursday	p.m.								
	a.m.								
Friday	p.m.								
	a.m.								
Saturday	p.m.								
	a.m.								
Sunday	p.m.								
Total									

Note: Must be completed each day. Estimate time in each department to nearest 1/2 hour (or 1 hour).

· expense for a part of the week in order
ow exact labor cost for the month.)

. great many other expenses are paid
quarterly, semiannual, or annual
:. These include insurance, real
e taxes, payroll taxes, and accounting
In constructing monthly operating
ments, it is desirable to show a charge
iese expenses each month rather than
them in full in the month of payment.
this type of expense, monthly charge
twelfth of the estimated annual ex-
e for each item) should be calculated
ised in preparing the monthly report.
e monthly estimates need not be
ed on the books, they are used only
eparing monthly statements.

wo other expenses, not included among
just mentioned, are entered on the
s each month so that a monthly charge
appear on the operating statement.
e two expenses are depreciation and
ebt expense. The method of computing
is explained elsewhere in this Guide.

he three types of operating expense
ints will now be discussed by number
itle. If the title of the account clearly
ates its nature, no further comments
e made.

. Expense

lant expenses are those incurred in
iting the physical plant of the business.
include repairs and maintenance of
ings and equipment, depreciation,
utilities, real estate taxes, and
ar expenses. The numerical chart of
ints specifically shows which accounts
lassed as plant expense.

l1) Indirect Labor - Charge to this
int all labor used for maintenance of
ings and equipment, janitorial labor,
ies of watchmen, and other plant labor
irectly related to processing. Many
s have very little indirect labor and
nerally is performed by processing
oyees. Under such circumstances, some part of the processing employees' wages might be charged here. The procedure described earlier for allocating payroll can be used to determine this cost.

(13) Plant Supplies - Charge to this account insecticides, cleaning materials, paper towels, paper bags, and similar supplies used in the business. Do not charge any processing supplies, or those used in the repair and maintenance of buildings and equipment.

(14) Utilities - Power, Light, Heat, and Water - This title is self-explanatory.

(15) Repairs and Maintenance - All expense incurred in the repair and maintenance of buildings and equipment, including cost of supplies and materials purchased for this purpose, is recorded here.

(16) Rent - This title is self-explanatory.

(18) Laundry - This title is self-explanatory.

(19) Depreciation - Building and Equipment - Records of fixed assets (such as buildings, processing and office equipment, and trucks) should be maintained for proper accounting and for tax purposes. Most stationery stores carry printed forms for this purpose which show date of purchase, purchase price, rate of depreciation, and amount of depreciation charged. From such records the total annual depreciation can be determined. One-twelfth of this amount is charged (debited) each month to this account (19) and credited to (253) Allowance for Depreciation, using the General Journal for the entry.

(21) Taxes - Real Estate, etc. - All taxes resulting from ownership of land, buildings, and equipment.

Selling and Delivery Expense

Most plants consider costs incurred in delivering products as part of selling

expense. Therefore, in this Guide, delivery and selling expenses are combined. However, firms with substantial delivery expenses may prefer to record them separately. There are sufficient unassigned numbers in the numerical chart of accounts to take care of this contingency.

(31) Wages, Salaries, Commissions - All wages, salaries, and commissions connected with selling and delivery are recorded here. The procedure described earlier for allocating payroll can be used to determine the amounts chargeable to this account.

When a commission or bonus has been earned by an employee but not actually paid to him during an accounting period, it should be debited to this account and credited to Accrued Salaries and Commissions (222). When paid in the next accounting period, the amount is debited to account 222.

(32) Advertising and Promotion - Include all costs of newspaper, magazine, and radio advertising. Also include stationery and postage used in direct mail promotion. These costs should be kept separate from Office Supplies and Postage (54).

(35) Delivery Truck Expense - Expenses incurred in operating trucks are charged to this account. Costs of gas and oil, tires, repairs, and licenses are included.

(36) Depreciation - Truck and Automobile - The cost of trucks and automobiles is usually recorded with other fixed assets. From these records, depreciation expense can be calculated and debited to this account. The credit entry would be to (253) Allowance for Depreciation and the entry would be handled through the General Journal.

General and Administrative Expense

General and administrative expense covers accounts used for recording costs of managing the business. It includ salaries of officers or proprietors, offi salaries and supplies, and insurance.

(51) Salaries - Officers/ Proprietor Partners - If officers are also employe of the firm, it is no problem to char their salaries to the proper account. some proprietorships and partnership however, the owner-operators make monthly charge against the business equi alent to this salary expense. In such case operating expenses are not fully stat and operating reports may not be tru comparable with those of other firms. fair and equitable charge should be ma for salaries, debiting this account (51) a crediting Proprietors/Partners - Drawi Account (313).

The owner may actually draw more less than the amount recorded as h salary. However, these monthly credi to his drawing account, together with h actual withdrawals which are debited his drawing account, all clear at the e of the period into the Capital Account. T result is that the operating stateme shows a realistic charge for officer salaries regardless of the amount actual drawn by the owners.

It is sometimes difficult to decide wh amount to charge each month for t owner's or partner's salary. One soluti to this problem is to use the amount th would be paid an outsider to perform t same administrative tasks that the own or partner performs.

(52) Salaries - Office - Charge he the salaries of all secretaries, bookkeeper accountants, and others engaged in offi work.

(54) Office Supplies and Postage - Th account includes the cost of stationer invoices, sales tickets, and accounti supplies. It also includes postage, exce that used in direct mail promotion whi is charged to Advertising and Promoti (32).

(55) Insurance - Record here all pre-
ms for fire and theft insurance cover-
buildings, equipment, and merchandise.
iness interruption insurance, personal
ility insurance, and surety bonds are
included in this account.

Do not include the expense of life in-
ance premiums. These should be
rged to Life Insurance Expense (804).
his connection, keep in mind that the
surrender value of life insurance
ld not be shown as an asset unless the
eficiary is the business itself.

Businesses carrying hospitalization in-
ance on employees or providing similar
rance benefits should set up a separate
unt for this expense. One of the un-
gned numbers between 50 and 99 in the
t of accounts should be used.

(56) Dues and Subscriptions - This ac-
t is for dues to business and trade
nizations and subscriptions to trade
azines.

(58) Telephone and Telegraph - Charge
is account all telephone and telegraph
. If considerable extra expense is
rred in telephone selling, the added
might better be charged to Advertising
Promotion (32).

(59) Bad Debt Expense - Some oper-
s do not consider an account bad until
s been declared uncollectible. Under
e circumstances, the usual procedure
charge it off directly to this account.

A better procedure is to anticipate
losses by setting up an Allowance for
btful Accounts (251). This is accom-
ned by first estimating bad debt expense
then determining the percentage this
nse is of sales. Each month a charge
doubtful accounts is made, using
thly sales figures and the estimated
debt percentage. Bad Debt Expense
is debited for this amount in the
eral Journal and the Allowance for
btful Accounts (251) is credited.

When an account is judged uncollectible, it is charged off to Allowance for Doubtful Accounts (251). This procedure has the effect of charging a bad debt to the month in which the sale was made, rather than a future time when the debt would bear no relationship to sales.

If the balance in the Allowance for Doubtful Accounts increases steadily, the percentage figure being used to calculate bad debts should be decreased. On the other hand, if the balance decreases too rapidly, the percentage figure should be increased.

(61) Donations - This title is self-explanatory.

(62) Travel and Entertainment - This account should be used to record travel and entertainment costs incurred in attending meetings in connection with the business, in entertaining suppliers or customers, and in like activities. Company entertainment for employees and similar expenses also should be charged to this account.

(63) Payroll Taxes - This title is self-explanatory.

(64) Other Taxes and Licenses - Include all local or State taxes and licenses required to conduct the business. Do not charge to this account income, real estate, or payroll taxes.

(65) Legal and Professional Fees - Accountant and legal fees paid for collecting accounts are recorded here.

(66) Depreciation - Office Equipment - See discussion under Depreciation - Building and Equipment (19) for proper procedure in accounting for depreciation of office equipment.

(67) Miscellaneous Expense - Only incidental or miscellaneous expenses that cannot be identified with any other account should be charged here.

Other Income--Other Outgo

Certain income and outgo do not result directly from operations of the business. It is accepted accounting practice to show these items at the bottom of the operating statement after the operating profit is calculated. This gives a clearer picture of results.

Other Income

The 700 group of accounts is used to record non-operating income. This includes such items as earned interest and discounts. Should all or part of a debt previously listed as uncollectible be paid, the net amount recovered is recorded as Other Income.

(701) Discounts Earned - Discounts taken for paying a bill within a given period are credited to this account. This is done by crediting account 701 in the General Ledger column of Form "B" when the entry is made showing payment of the bill.

(703) Interest and Earnings - Financing - Credit to this account any interest earned on notes receivable from customers, as well as interest and carrying charges earned from installment accounts. The method of recording carrying charges is illustrated on Form "A."

(704) Bad Debts Recovered - Whenever part or all of an account that has been written off the Allowance for Doubtful Accounts is subsequently recovered, the net amount recovered (after deducting collection expense) should be credited to this account. There is an example on Form "A," item 9.

(706) Cash - Over and Short - As mentioned previously, cash received (currency and checks) should be deposited in the bank each day. If the cash either exceeds or is short of the amount shown on Form "A," the difference should be recorded here.

If cash exceeds the amount shown o
Form "A," the difference is credited t
this account using the General Ledge
columns on Form "A." If cash is shor
the difference should be made up from th
petty cash and added to the deposit. Whe
petty cash is reimbursed, this shortag
would be charged to the Cash - Over an
Short account.

Other Outgo

Other Outgo accounts in the Genera
Ledger are numbered from 800 to 89
Among the accounts so classified ar
Discounts allowed, interest, and life in
surance expense.

(801) Discounts (Cash) Allowed - Her
would go any deductions allowed customer
for paying their accounts within a certai
period. This type deduction should not b
confused with reductions in selling pric
for volume purchases.

(802) Interest Expense - All interes
expenses incurred by the firm in borrow
ing money, as well as interest paid o
installment purchases of equipment, i
recorded here.

(804) Life Insurance Expense - Whe
a life insurance premium is paid fro
funds of the business and the business i
the beneficiary, that portion of the pre
mium that is expense should be charge
to this account. A portion of the premiu
is capitalized by increasing the cas
surrender value of this asset. (See (142
Cash Surrender Value - Life Insurance).

If premiums are paid with funds of th
business but the business is not the bene
ficiary, the proper procedure is to charg
(debit) the premiums to the proprietor'
or partner's drawing or capital account.

Generally, incorporated businesse
can be designated as beneficiaries of in
surance policies. Frequently partnership
are shown as beneficiaries and, under som
circumstances, individual partners are th

eficiaries. In a single proprietorship, individual's estate rather than the ness is generally the beneficiary.

Balance Sheet Accounts

This section of the LFP Guide contains ific instructions for preparing a bal- sheet. Assets are discussed first; liabilities; and, last, net worth.

A typical balance sheet is shown on s 6 and 7.

Current Assets

Current assets are made up of cash, ivables, and inventories. Accounting edures will be explained for each of classifications, with the various unts identified by number and title.

Cash is the first asset recorded on a ice sheet. It includes cash in the bank ell as cash on hand.

101) Cash - In Office - Cash is kept e office to pay certain minor expenses ected with operating the business. money, known as the petty cash fund, ept separate from the regular cash ipts recorded on Form "A" and de- ed in the bank.

s cash is taken from the petty cash to pay small bills, it is replaced with eipted bill or petty cash slip showing amount paid, to whom, and for what. of these slips and receipted bills d also show the account number to the expense will be charged. Peri- lly, the petty cash fund is replenished an entry made to record the expendi-

his example illustrates the usual edure for handling petty cash. At the beginning of the month, the petty cash fund is $100. At the end of the month, the petty cash fund contains paid bills and other evidence of expenditures amounting to $88.40 and $11.60 in cash. These bills and other expense records can be filed in an envelope, with a summary on the outside of the envelope showing the amounts and account numbers to be charged. A check for $88.40 is then drawn to the order of Petty Cash, restoring the fund to its original $100.

The method of recording petty cash expenditures is illustrated on Form "B," items 16 - 20.

(103) Cash - In Bank(s) - Total receipts, as shown on Form "A," should be deposited in the bank daily. The monthly statement from the bank should be reconciled with the firm's books. Any charges for bank services or any credits require a General Journal entry.

Receivables

The typical balance sheet shows receivables in four groups:

(111) Notes - Due from Customers

(113) Accounts - Due from Customers

(114) Accounts - Due from Officers and Employees

(115) Bank - Financing Reserve

Other groups can be set up if necessary, using unassigned numbers from the chart of accounts.

(111) Notes - Due from Customers - This includes promissory notes accepted in settlement of open accounts and installment notes received from food plan or freezer provisioning activities. If there are sizable numbers of these notes, it would be well to open a separate ledger with an account for each one. On Form "A," control columns have been set up for Notes

Receivable as well as Accounts Receivable.

(113) Accounts - Due from Customers - These are charges made on open account. All charges to accounts receivable and all payments on account are entered in special columns provided on Form "A." Totals of these columns provide the control figures for the General Ledger account. An individual card or ledger sheet is used for each customer, showing all charges and all credits. It is important that the sum of the balances in these individual accounts agree with the total control figure in the General Ledger.

(114) Accounts - Due from Officers and Employees - Any charge, loan, or advance to officers (if a corporation), or to employees should be entered here. It is important to keep these accounts separate from Accounts - Due from Customers.

(115) Bank - Financing Reserve - Many banks advance funds with either notes or accounts receivable assigned as security. It is a common practice for a bank to advance 90 to 95 percent of the face value of the notes or accounts so assigned, withholding 5 or 10 percent until the loan is liquidated. The firm borrowing the money records the amount withheld under (115) Bank - Financing Reserve.

To illustrate, assume that a total of $4,000 in notes receivable has been assigned to the bank as security for a loan. The bank issues a credit memo for $3,600 which indicates this amount has been credited to the firms account. Using this memo, the borrower's entry on Form "A" Cash Received and Sales Record, would be:

Debit - (103) Cash - in Bank	$3,600	
Debit - (115) Bank - Financing Reserve (Using General Ledger column)	400	
Credit - (205) Notes Payable - Bank (Using General Ledger column)		$4,000

Procedures from here on vary in de- tail depending upon terms of the loan, suc as whether the bank or the borrower col lects the notes receivable, whether col lections by the bank are with or withou recourse, and so on.

Assume, however, that the firm bor rowing the money makes collection of tw of the assigned notes for a total of $1,000 Receipt of this amount would be recorde on Form "A" as follows:

Debit - (103) Cash - in Bank	$1,000
Credit - (111) Notes - Due from Customers	1,000

Again depending on arrangements wit the bank, the procedure might be to dra a check payable to the bank for the ful amount of the collection ($1,000). Thi would be entered on Form "B," Cash Dis bursed and Purchase Record, as follows:

Debit - (205) Notes Payable - Bank	$1,000
Credit - (103) Cash in Bank	1,000

This reduces the bank loan from $4,00 to $3,000.

If the procedure of remitting to th bank in full is followed, the bank woul issue a credit memo for $100, the 1 percent of the $1,000 withheld at the tim of the loan. Using this memo, the entr on Form "A" would be:

Debit - (103) Cash - in Bank	$100
Credit - (115) Bank - Financing Reserve	100

The General Ledger column would b used for the credit entry.

If a check is issued to the bank for onl $900, the entry on Form "B" would be:

Credit - (103) Cash - in Bank	$900	
Credit - (115) Bank - Financing Reserve	100	
Debit - (205) Notes Payable - Bank		$1,000

The result of these procedures is tha notes receivable and notes payable hav

h been reduced by $1,000 and the $100 ıheld by the bank has been returned, ıer by crediting to the borrowing firm's k account, as in the first illustration, applying it to the loan as shown in the ond illustration.

A careful record should be maintained each note or account assigned to the k. The record can be on a card or a it-credit ledger sheet. The record ıld show amount, date assigned, date , payment on account, renewals, and ted information.

Whenever a financial statement is pared, a footnote should indicate the unt of notes or accounts receivable have been assigned as security for s shown on the statement.

(251) Allowance for Doubtful Accounts - Bad Debt Expense (59) for a discussion ıis account.

ntories

Inventory accounts number 131-135 are ussed together, since the same com- ts apply to all of them.

(131) Inventory - Meats and Poultry - For Resale

132) Inventory - Frozen Food - For Resale

133) Inventory - Freezers - For Resale

134) Inventory - Freezing Supplies - For Resale

135) Inventory - Processing Supplies

Cost of merchandise going into inventory ld be recorded at the delivered cost. is, it should include both the purchase e and the cost involved in getting the chandise delivered to the plant. In ılating cost of sales, this same de- ed cost should be used.

Inventorying methods vary and no one method can be recommended for all firms. Probably most lockers and freezer provisioners use the First In - First Out method (FIFO). This means that merchandise and supplies are inventoried at the price most recently paid for the product.

If processing plant-owned products constitutes an important part of the business, a rather large volume of partially processed products is often carried over from one period to another. It is sometimes necessary to inventory these products at partially processed value rather than at raw material cost or at finished value. When such a procedure is determined to be necessary, the work-in-process valuation should be raw material costs plus direct processing labor cost and processing supplies used.

Other information on inventories and inventorying methods was presented earlier in the Guide in the section, "Cost of Sales."

Investments

Frequently a firm owns certain assets which are not necessary to or used in the operation of the business. These may include Government bonds, real estate not used in the business, and similar assets. Cash surrender value of life insurance also comes under this category, if the business is the beneficiary named in the policy.

(141) U. S. Bonds - Treasury bonds are used to illustrate the accounting procedure for handling this type of investment. When bonds are purchased for the business, the investment appears as an asset in this account and the income derived from it goes to Other Income. An account number should be selected to record this income. This could be (702) Income from Investments.

When such an investment is made and it is intended that the sum invested be

taken out of the business, the procedure is different. The investment is not shown as an asset but rather is charged to the proprietor's or partner's drawing or capital account, thus recording the removal of funds from the business.

(142) Cash Surrender Value - Life Insurance - This asset is shown on the books of the business only if the business is the beneficiary. Premium expense should be charged to (804) Life Insurance Expense, as discussed under that account. The insurance agency can be helpful in determining cash surrender value.

Prepaid Accounts

Frequently certain expenses are paid in one accounting period but the benefits derived from the expenditure are realized over a considerable number of accounting periods. To report the entire expense in a single monthly operating statement would distort that statement and reduce its value. For this reason, an accounting procedure should be used whereby the expense can be prorated on a monthly basis.

Most locker and freezer provisioners will probably need to set up three prepaid accounts:

(161) Prepaid Interest

(162) Prepaid Taxes

(163) Prepaid Insurance

The following example, using account (163) Prepaid Insurance, illustrates the accounting procedure used for all prepaid accounts.

A yearly insurance premium is $600. If this were charged directly to (55) Insurance in the month in which the premium was paid, that monthly statement would be distorted and would not be comparable with others.

To prevent this, and at the same time to indicate that this expense has been paid in advance, charge the full amount of this bill to Prepaid Insurance (163). Then, before the close of the period, make a General Journal entry debiting (55) Insurance with one-twelfth of the $600 expense and crediting (163) Prepaid Insurance with the same amount. This is continued each month until the entire amount has been wiped out. This procedure is repeated when premiums are paid again.

Most stationery stores carry standard forms that are useful in recording important insurance information, such as amount of insurance, dates premiums are due, coverage, and similar data.

Fixed Property and Equipment

Fixed property and equipment are part of the total assets of a firm. The typical balance sheet illustrates how these assets should be presented, along with allowances for depreciation.

Five accounts will be sufficient to record the fixed property and equipment of most firms. They are:

(171) Land

(172) Building

(173) Plant Equipment

(174) Truck(s) and Automobile(s)

(175) Office Equipment

When fixed property or equipment is disposed of, the gain or loss -- after deducting the allowance for depreciation from the purchase price -- is handled through the Other Income or Other Outgo accounts. It would be appropriate to establish an account to record this transaction, such as (705) Gain or Loss on Sale of Fixed Assets.

Most firms have small investment in re equipment and will record it with ount (173) Plant Equipment. However, considerable store equipment is owned used in the business, a special account y be set up to record this asset. Any sed number in the 170 account group example, 176) should be selected.

Land and buildings not used in the iness but held for investment purposes uld be recorded in the 140 account up and classified as investments.

Liabilities

Liabilities are debit items and are the igations of the business. Various liability ounts are discussed in this section of Guide in the order in which they appear he typical balance sheet.

ables

Payables are described in this Guide in er of time of settlement. For example, l) Accounts Payable - Trade is for ounts that are generally due and payable request or at the end of the month. On other hand, items under (203) Notes able - Trade are generally longer term ilities.

(201) Accounts Payable - Trade - Ines and bills not paid during the period ered by the operating statement should entered on the books before they are sed or before the operating statement and nce sheet are prepared. If this is not e, the books will not present a true pice of the firm's inventories or liabilities.

The General Journal, Form "C," illustes how these payables are entered on books. When there are a number of h accounts each month, they can be dled in the same manner as accounts eivable; that is, a separate ledger sheet each.

An alternative method of handling these accounts payable is to enter them on the Cash Disbursed and Purchase Record, Form "B." Entry number 21 on the typical form illustrates this procedure. Instead of making an entry in the General Journal, the net amount of the accounts payable is debited in the proper Merchandise Purchases column and credited to "Accounts Payable - Trade" in the General Ledger column. Note that the notation "Jnl Ety" (Journal Entry) is used in the Check Number column to indicate that no check was issued.

This procedure can also be used for recording other unpaid bills. Such bills are debited to the proper expense account and credited in the General Ledger column to Accounts Payable - Trade. When the unpaid bills are of a recurring nature, such as the power bill, this procedure need not be followed if one such bill is paid and posted to the books each month.

(203) Notes Payable - Trade - Notes payable are occasionally given to suppliers in settlement of an open account. When these liabilities have been recorded in account (201) Accounts Payable - Trade, and later a note is given, the procedure then is to debit (201) Accounts Payable - Trade and credit (203) Notes Payable - Trade. The General Journal, Form "C," is used for making the entry.

(205) Notes Payable - Bank(s) - The procedure here is the same as for (203) Notes Payable - Trade. These obligations may be in the form of a single or a series of notes, or notes secured by assigning notes or accounts receivable. The method of liquidating such notes varies considerably, depending upon arrangements with the lending bank. All payments on notes are recorded on Form "B" as illustrated. The total of the individual notes payable should be checked and reconciled with the control figures in the General Ledger.

An up-to-date schedule of all notes payable should be maintained. This

schedule should show the amount, date of payment, to whom and where payable and related information.

Additional information on this account is given in the discussion of (115) Bank - Financing Reserve.

Accrued Expenses

Accrued expenses are obligations that have been incurred in the course of conducting the business but which will not be paid until a later date.

(221) Accrued Interest Payable - Interest paid in advance is shown in account (161) Prepaid Interest. If, however, interest is not to be paid until some future date, that portion of the interest expense incurred during the accounting period should be recorded so that the obligation will show in the books. The procedure is to enter in the General Journal a debit to (802) Interest Expense and a credit to (221) Accrued Interest Payable.

(222) Accrued Salaries and Commissions - The need to accrue salaries and commissions arises when expenses have been incurred but not paid by the end of an accounting period. It is important to show these expenses in the operating statement and these liabilities in the balance sheet.

The procedure for showing this is by Journal entry, debiting the proper wage or commission account and crediting (222) Accrued Salaries and Commissions. When the obligation is paid at a later date account (222) is debited and the liability liquidated.

(223) Accrued Payroll and Withholding Taxes

(226) Accrued Sales Taxes

These two accounts are provided to record monies that have either been withheld from payrolls or collected from customers and are to be paid to some agenc such as the Internal Revenue Servic Form "B" illustrates how to recor amounts withheld. Form "A" shows ho sales taxes collected from customers ar recorded.

(241) Mortgage Payable - This title i self-explanatory.

Reserves

A reserve is an account with a cred balance, set up because the expenses c operation have decreased an asset o created a liability. Most firms will nee these two accounts:

(251) Allowance for Doubtful Account

(253) Allowance for Depreciation

The procedure for setting up thes accounts is covered elsewhere in th Guide. See the discussion of account (5 Bad Debt Expense for information o (251) Allowance for Doubtful Accounts Discussions of accounts (19) Depreciation Building and Equipment, (36) Depreciation Truck and Automobile, and (66) Deprecia tion - Office Equipment also refer t (253) Allowance for Depreciation.

These accounts are shown on the lef side of the balance sheet as deduction from an asset account. Allowance fo Doubtful Accounts (251) is shown as deduct from total receivables. Allowanc for Depreciation (253) is shown as a deduc from the various fixed asset accounts.

Deferred Locker Rental Revenue

The trend in the industry is to conside storage revenue as earned in the period i which the storage service was sold. Thus the balance sheet in this Guide shows n deferred locker-rental revenue.

Many operators who receive a sub-
tial portion of their revenue from
ıal locker rentals may wish, however,
ıow this deferred income on the bal-
: sheet. When this deferred income is
vn only on the end-of-the year balance
t the following procedure is suggested.

Set up a General Ledger account (261)
rred Locker Rental Revenue. At the
of the year, determine the amount of
rned locker rental revenue. Transfer
amount by General Journal entry out
e storage revenue account by debiting
) Storage, and crediting (261) Deferred
ker Rental Revenue. At the beginning
e next accounting period, reverse this
y so that the deferred revenue will be
vn as current revenue.

A number of methods have been de-
ped for calculating the amount of de-
ed locker rental revenue. Table 3 illus-
es one method. The percent deferred
ways 4.17 the first month of the fiscal
; 12.50, the second month; and so on.

Some operators constructing end-of-
month balance sheets may wish to
this deferred locker rental revenue
month. In that event, a different
unting procedure is necessary. One
tical method is to credit all revenue from short-term locker rentals, bulk storage and other refrigerated storage to (401) Storage. Revenue from annual locker rentals, however, is credited to (261) Deferred Locker Rental Revenue. At the end of each month the earned portion of this revenue is transferred from this account to (401) Storage, using the techniques of determining earned locker rentals described in the section, "Storage Revenue."

Net Worth

Many firms in the locker and freezer provisioning industry are organized as single proprietorships or as partnerships. The net worth accounts necessary for this type of ownership are:

(311) Proprietors/Partners - Capital Account(s)

(313) Proprietors/Partners - Drawing Account(s)

(351) Profit and Loss

If the firm is organized as a corporation, net worth accounts would be designated:

(311) Capital Stock - Authorized and Issued

e 3. - *Method of calculating deferred locker rental revenue*

Month	Annual rentals billed	Deduct rentals cancelled	Net annual rentals	Percent deferred	Amount deferred
ary	$800	-	$800	4.17	$33.36
ıary	600	-	600	12.50	75.00
1	400	-	400	20.83	83.32
l	400	-	400	29.17	116.68
	500	$50	450	37.50	168.75
	400	-	400	45.83	183.32
	300	50	250	54.17	135.42
st	200	-	200	62.50	125.00
ember	400	-	400	70.83	283.32
ber	500	-	500	79.16	395.80
nber	800	-	800	87.48	699.84
nber	800	-	800	95.83	766.64
Total	6,100	100	6,000		3,066.45

(313) Surplus

(351) Profit and Loss

If the firm is organized as an incorporated cooperative, the accounts would be designated as follows:

(311) Preferred Stock - Authorized and Issued

(312) Common Stock (Voting or Membership Stock)

(313) Undistributed Savings

(351) Savings and Loss

Posting to the General Ledger

All posting to the General Ledger is from Form "A" - Cash Received and Sales Record; Form "B" - Cash Disbursed and Purchase Record; and Form "C" - General Journal.

Form "A" shows end-of-the-month totals. The total of some columns, such as accounts 103, 111, 113, 226, are posted directly to the General Ledger. However, when the term "various" is used as shown in the instructions at the bottom of the form, this means that posting must be by individual items. For example, each item in the General Ledger columns on the left-hand side must be posted separately, or else like items in these columns must be combined in a summary for posting.

The information in the All Sales Income column ($12,900) on the left-hand side of Form "A" is not posted. This information is broken down on the right-hand side and is posted to the appropriate accounts as shown on the illustrated form.

The same general procedure applies in posting from Form "B" as in posting from Form "A." Items in the General Ledger columns on the left hand side are posted individually. The information in the Operating Expense column and th[e] Merchandise Purchases column is n[ot] posted, as it is further broken down on th[e] right-hand side. The remaining column[s] on the left-hand side are posted directl[y] to the General Ledger.

As an aid in posting, the right-hand sid[e] provides columns for further classifyin[g] operating expenses and merchandise pur[-] chased. Operating expenses are classifie[d] into three types - plant operating expense[,] selling and delivery expense, and genera[l] and administrative expense. The variou[s] items listed in these columns are posted b[y] the account number identifying the expense[.] The totals of these columns are not poste[d].

Also on the right-hand side are column[s] for classifying merchandise purchases[.] The totals of these columns may be poste[d] directly to the General Ledger, with th[e] possible exception of the column heade[d] Other. Depending on the use made of th[e] columns, it may be necessary to post indi[-] vidual items from this column.

Most entries on Form "C" are poste[d] as individual items to the various Genera[l] Ledger accounts.

Trial Balance

The four-page trial balance form whic[h] follows will assist in preparing the monthl[y] operating statement and balance shee[t]. Each account in the General Ledger i[s] listed by name and number, with blan[k] spaces for additional accounts that may b[e] required. The accounts are listed to con[-] form to the chart of accounts.

When the debit or credit balance o[f] each account from the General Ledger i[s] entered on this form and the form "bal[-] ances," the operating statement and th[e] balance sheet can be prepared.

Operators desiring to use a trial bal[-] ance form may buy suitable blank columna[r] paper or have a supply printed.

TRIAL BALANCE FORM - General Ledger
Used to prepare Balance Sheet and Operating Statement

Balances - Assets	Acct. No.	Amount	Credit Balances - Liabilities	Acct. No.	Amount
			PAYABLES		
h - in office	101		Accounts - trade	201	
	102			202	
ank(s)	103		Notes - trade	203	
IVABLES				204	
es - due from customers	111		Notes - bank(s)	205	
	112			206	
ounts - due from			ACCRUED		
customers	113		Interest	221	
ounts - officers/			Salaries and commissions	222	
employees	114		Payroll-withholdings	223	
k - financing reserve	115			224	
NTORIES				225	
ts and poultry -			Sales taxes payable	226	
r resale	131				
zen foods - for resale	132		Mortgage payable	241	
ezers - for resale	133		Allowance for doubtful		
ezing supplies -			accounts	251	
r resale	134			252	
cessing supplies	135		Allowance for depreciation	253	
	136				
STMENTS			NET WORTH		
. Bonds	141		Proprietors capital account	311	
n surrender value -				312	
e insurance	142		Proprietors draw'g account	313	
	143			314	
AID				315	
rest	161				
es	162				
rance	163		Profit and loss account	351	
	164				
D PROPERTY AND					
IPMENT					
d	171				
ding	172				
t equipment	173				
ck(s) and automobile(s)	174				
ce equipment	175				
	176				

	Acct. No.	MONTH				YEAR TO DATE			
		Debits		Credits		Debits		Credits	
SALES									
Storage	401								
Processing	402								
	403								
Sales - meats	404								
Sales - frozen foods	405								
Sales - other merchandise	406								
TOTAL SALES									
Deduct - COST OF SALES									
Direct labor - processing	502-a								
Processing supplies used	502-b								
Direct cost charged to plant owned products	502-c								
Cost of meat sold	504								
Cost of frozen foods sold	505								
Cost of other merchandise sold	506								
TOTAL COST OF SALES									
GROSS MARGINS									
PLANT									
Indirect labor	11								
	12								
Plant supplies	13								
Utilities and power, light, heat, and water	14								
Repair and maintenance	15								
Rent	16								
	17								
Laundry	18								
Depreciation - building and equipment	19								
Taxes - real estate, etc.	21								
	22								
	23								
SELLING and DELIVERY									
Wages, salaries, and commissions	31								
Advertising and promotion	32								
	33								
	34								
Truck expense	35								
Depreciation - truck and auto	36								
	37								
	38								
	39								

perating Expenses - Continued	Acct. No.	MONTH		YEAR TO DATE	
		Debits	Credits	Debits	Credits
NERAL ADMINISTRATIVE					
laries - off./prop./part.	51				
laries - office	52				
	53				
fice supplies and postage	54				
surance	55				
es and subscriptions	56				
	57				
lephone and telegraph	58				
d debt expense	59				
nations	61				
avel and entertainment	62				
yroll taxes	63				
her taxes and licenses	64				
gal and professional fees	65				
preciation - office equipment	66				
scellaneous	67				
	68				
	69				
l operating expenses					
rating profit or loss					
: OTHER INCOME					
scounts earned	701				
	702				
erest and earnings - financing	703				
d debts recovered	704				
in or loss on sale of fixed					
ssets	705				
sh - over and short	706				
	707				
uct: OTHER OUTGO					
scounts (cash) allowed	801				
erest expense	802				
	803				
fe insurance expense	804				
	805				
	806				
	807				
	808				
	809				
t profit or loss					

U. S. GOVERNMENT PRINTING OFFICE: 1959 O - 511802

Other Publications Available

Business Management of Frozen Food Locker and Related Plants, Marketing Research Report 258, James J. Mullen and Lloyd M. DeBoer

Merchandising Frozen Food by Locker and Freezer Provisioning Plants, Marketing Research Report 313, Bert D. Miner

1955 Survey - Frozen Food Locker Plants, Utilization Research Report 1, P. C. Wilkins, L. B. Mann, and B. D. Miner

Producing and Merchandising Sausage in Small Plants, FCS Circular 5, C. G. Randell

Inedible Offal as a Hog Feed - Processing and Feeding by Small Slaughterers, FCS General Report 37, Bert D. Miner

Operating Costs of Selected Frozen Food Locker Cooperatives, Bulletin 71, Paul C. Wilkins and L. B. Mann

A copy of each of these publications may be obtained upon request while a supply is available from --

Information Division
FARMER COOPERATIVE SERVICE
U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON 25, D. C.

A Bibliography of

ORGANIC ACIDS IN HIGHER PLANTS

Agricultural Handbook No. 164

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

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A BIBLIOGRAPHY OF ORGANIC ACIDS IN HIGHER PLANTS[1]

By M. L. Buch, *chemist, Eastern Utilization Research and Development Division, Agricultural Research Service*

Scientific interest in the organic acids of higher plants has prompted a search of the literature and tabulation of these acids and their occurrence.

Nonvolatile, non-nitrogen-containing, carboxylic acids whose structure is generally accepted (*44, 267, 483*)[2] are included. Fatty acids, long-chain polymers—such as pectins—and compounds which contain a sugar group as part of the molecule are excluded. Thus, carboxylic sapogenins are included but saponins are not. The acids reported are those that are found in the free state or as salts, not as esters.

Plants are listed by family and by genus and species. The family names are those given by Willis (*789*), and, when possible, the names of the genus and species follow this system. Where the name disagrees with that in established usage by the Department of Agriculture the latter name is given in parentheses following the original name. Where the name is apparently misspelled, doubtful, or not known by the Department a query(?) has been inserted following the original name. Only spermatophyta are included.

Titles of articles and books published in other languages have been translated into English. In those cases in which the report could not be verified by consulting the original paper or an abstract, a secondary reference is substituted.

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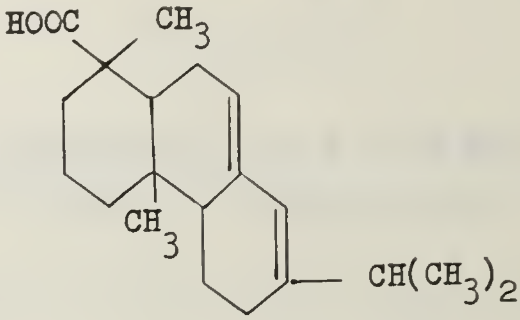
[1] This review covers all publications through 1954 and a limited number published in 1955 and 1956.
[2] Italic numbers in parentheses refer to Literature Cited, p. 51.

Abietic Acid



Family	Genus and species	Source	Reference
Pinaceae	----------	Colophony	(*37, 113, 162, 169*)
	Pinus abies (*Picea abies*)	Resin	(*48, 419*)
	P. larix (*Larix decidua*)	----------	(*419*)
	P. palustris	Resin	(*35, 258, 339*)

Aconitic Acid

COOH
|
C=CH COOH
|
CH_2COOH

Family	Genus and species	Source	Reference
Chenopodiaceae	*Beta vulgaris*	Juice	(*392, 395*)
		Unripe beet	(*705*)
Compositae	*Achillea millefolium*	----------	(*285*)
	Helianthus annuus	----------	(*58*)
Gramineae	*Avena sativa*	----------	(*474*)
	Hordeum vulgare	Etiolated shoot.	(*168*)
		Seedling	(*314, 474*)
	Saccharum officinarum	Juice	(*36; 50; 411; 603; 604; 605; 694; 699; 703; 704, ref. 162; 784; 811; 817*)
	Secale cereale	----------	(*474*)
		Seedling	(*668*)

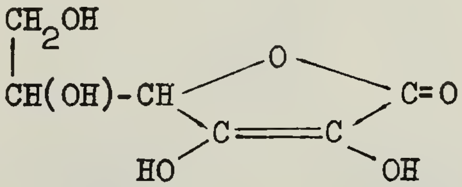
Family	Genus and species	Source	Reference
	Aconitic Acid—Continued		
Gramineae	*Sorghum vulgare*		*(414, 744)*
		Scale from evaporation pans.	*(507)*
		Juice	*(745, 786, 787)*
	Triticum sp		*(473)*
		Sprout	*(667)*
	T. sativum (*T. aestivum*)	Seedling	*(668)*
	Zea mays	Sprouting seed	*(668)*
Leguminosae	*Phaseolus coccineus*		*(58)*
Ranunculaceae	*Aconitum* spp		*(54;58;108;160, p.567, ref.3;497)*
	A. columbianum		*(49)*
	A. heterophyllum		*(322)*
		Root	*(769)*
	A. napellus		*(50)*
	A. septentrionale	Tuber and root	*(315)*
	A. vernalis (*Adonis vernalis*).		*(497)*
		Leaf	*(388)*
	Delphinium barbeyi		*(49)*
	D. bicolor		*(49)*
	D. consolida	Leaf sap	*(781)*
	D. cucullatum		*(49)*
	D. geyeri		*(49)*
	D. glaucescens		*(49)*
	D. nelsonii		*(49)*
Solanaceae	*Solanum lycopersicum* (*Lycopersicon esculentum*).	Fruit	*(109)*
		Root, leaf, and ripe fruit.	*(116)*
Umbelliferae	*Angelica archangelica*	Root	*(690)*

Adipic Acid

$$HOOC—CH_2CH_2CH_2CH_2COOH$$

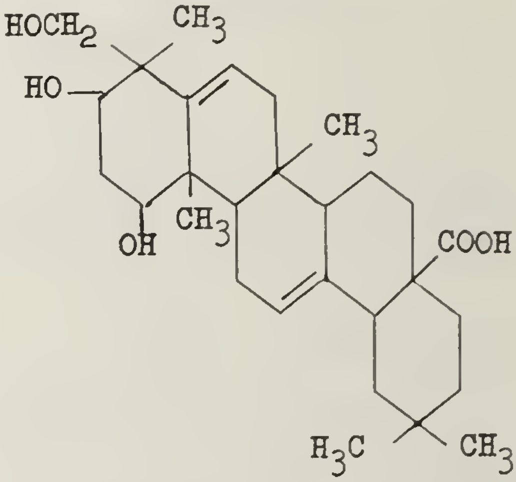
Chenopodiaceae	*Beta vulgaris*		*(396, 742)*

Ascorbic Acid



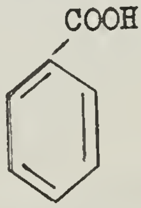
Since its structure was elucidated by Svirbely and Szent-Györgyi in 1932 (*691*, *692*), ascorbic acid has been reported in almost every plant in which its presence has been investigated.

Bassic Acid



Family	Genus and species	Source	Reference
Sapotaceae	*Achras sapota*	Seed	(*276*)
	Bassia butyracea (*Madhuca butyracea*).	----do	(*276, 277*)
	B. latifolia (*M. latifolia*)	----do	(*276, 277*)
	B. longifolia (*M. longifolia*).	----do	(*276*)
	B. parkii	----do	(*276, 277*)
	Dumoria heckelii	----do	(*276*)
	Mimusops djave (*Baillonella toxisperma*).	----do	(*276*)
	M. elengi	----do	(*276*)
	M. hexandra	----do	(*276*)
	Payena lucida	----do	(*276*)

Benzoic Acid



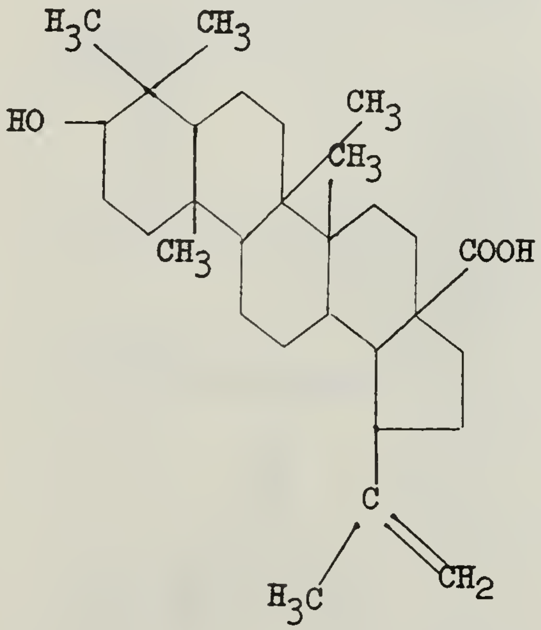
Compositae	*Dahlia* sp		(*511*)
Droseraceae	*Drosera rotundifolia*		(*796*)
Empetraceae	*Empetrum nigrum*	Leaf	(*306*)
Ericaceae	*Vaccinium macrocarpum*	Berry	(*239, 434. 467*)
	V. oxycoccos	----do	(*239, 415, 477, 599*)
	V. vitis-idaea	----do	(*51, 239, 328, 382, 403, 477*)
Gramineae	*Bambusa arundinacea*	Young shoot	(*218*)

Family	Genus and species	Source	Reference

Benzoic Acid—Continued

Family	Genus and species	Source	Reference
Leguminosae	*Daviesia latifolia*	Leaf and stem	*(555)*
	Myroxylon pereirae	Balsam	*(361)*
	M. toluiferum	do	*(110, 146)*
Lentibulariaceae	*Pinguicula vulgaris*	Leaf	*(405)*
Lilaceae	*Dracera draco*	Resin	*(715a)*
	Gloriosa superba	Tuber	*(123)*
Magnoliaceae	*Illicium anisatum*	Fruit and seed	*(498)*
Myrtaceae	*Psidium* spp		*(515)*
Papaveraceae	*Papaver somniferum*		*(635)*
Pinaceae	*Agathis australis*		*(457)*
Rosaceae	*Prunus serotina*	Bark	*(550)*
		Leaf	*(551)*
Rubiaceae	*Coffea* sp		*(410, 516)*
Rutaceae	*Casimiroa edulis*	Seed	*(549)*
Scrophulariaceae	*Digitalis purpurea*		*(331)*
Styracaceae	*Styrax* sp		*(372; 718, p. 507, ftn. 4.)*
	S. benzoin	Resin	*(715a)*

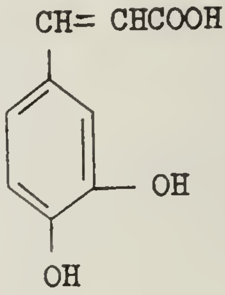
Betulinic Acid



Family	Genus and species	Source	Reference
Apocynaceae	*Alyxia buxifolia*	Bark	*(21)*
Cornaceae	*Cornus florida*		*(606)*
Gentianaceae	*Menyanthes trifoliata*	Rhizome	*(671)*
Loranthaceae	*Nuytsia floribunda*	Leaves, stems, and bark.	*(21)*
Myrtaceae	*Melaleuca* (6 spp.)	Bark	*(21)*
	Syncarpia laurifolia	do	*(579)*
Platanaceae	*Platanus acerifolia*	do	*(100)*
Punicaceae	*Punica granatum*	Leaves and bark	*(98)*
Rhamnaceae	*Ziziphus vulgaris*	Seeds and bark	*(333)*

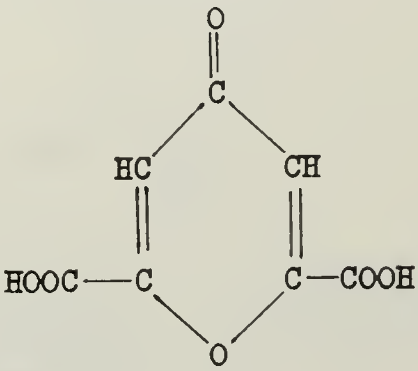
Family	Genus and species	Source	Reference

Caffeic Acid



Aquifoliaceae	*Ilex aquifolium*	Leaf	(678)
	I. paraguarensis	do	(678)
Compositae	*Anthemis nobilis*	Flower	(547)
	Taraxacum officinale	Root	(546)
Labiatae	*Melissa* sp	Leaf	(272)
Pinaceae	*Larix europaea* (*L. decidua*.	Resin	(37)
Ranunculaceae	*Aconitum septentrionale*		(315)
	Clematis vitalba	Flowering branch.	(730)
Rosaceae	*Crataegus oxyacantha*	Leaf, fruit, and flower.	(187)
Rubiaceae	*Cinchona cuprea*	Bark	(349)
	Coffea spp	Bean	(187)
		Leaf	(678)
Scrophulariaceae	*Digitalis purpurea*		(88, 331)
	Scrophularia nodosa	Root	(317)
Solanaceae	*Solanum tuberosum*		(323)
Umbelliferae	*Angelica archangelica*		(690)
	Conium maculatum		(288)

Chelidonic Acid



Amarylidaceae			(684)
	Agave sp	Leaf	(581)
	A. falcata	Anther and perianth.	(582)
	Amaryllis crispa (*Hessea crispa*).	Leaf, perianth, and anther.	(582)

Family	Genus and species	Source	Reference
	Chelidonic Acid—Continued		
Amarylidaceae	*Androstemma junceum* (*Conostylis androstemma*).	Leaf, perianth, and anther.	(*582*)
	Anigozanthos humilis	Leaf	(*582*)
	A. preissii	Anther	(*582*)
	Anoiganthus breviflorus	Pericarp	(*582*)
	Blancoa canescens	Leaf and perianth.	(*582*)
	Brunsvigia angustifolia	Leaf and flower	(*582*)
	B. josephinea (*B. gigantea*).	Pericarp, leaf, perianth, and anther.	(*582*)
	B. uitenhagensis	Flower	(*582*)
	Buphane ciliaris	Leaf, perianth, and anther.	(*582*)
	Carpolyza spiralis	Leaf, perianth, and bulb.	(*575*)
	Conostylis (12 spp.)		(*582*)
	Crinum capense (*C. longifolium*).	Leaf, perianth, and pedicel.	(*582*)
	C. kirkii	do	(*582*)
	C. purpurascens	Leaf, perianth, and anther.	(*582*)
	Cummingia tenella (*Conanthera campanulata*).	Perianth	(*582*)
	Galanthus nivalis	Leaf, pedicel, anther, and perianth.	(*582*)
	G. plicatus	Leaf, perianth, pedicel, and bulb.	(*582*)
	Hessea maximiliani	Flower	(*582*)
	Hippeastrum mandoni	Leaf, perianth, anther, and pedicel.	(*582*)
	Hypoxis juncea	Flower	(*582*)
	H. minuta	Flower and leaf	(*582*)
	H. probata	Perianth	(*582*)
	H. serrata	Perianth, leaf, and anther.	(*582*)
	H. villosa	Leaf, and perianth.	(*582*)
	Ixiolirion montanum	Perianth, leaf, and flower.	(*582*)
	Lanaria plumosa	Leaf and perianth.	(*582*)
	Leucojum (5 spp.)		(*582*)
	Lophiola americana	Leaf and flower	(*582*)
	Lycoris aurea	Perianth, anther, pedicel, and pericarp.	(*582*)
	Narcissus (14 spp.)		(*582*)
	Panoratium canariense	Leaf and anther	(*582*)
	Sternbergia colchiciflora	Leaf, perianth, anther, and seed.	(*582*)
	S. lutea	Leaf, perianth, and anther.	(*582*)
	Tribonanthes uniflora	Perianth	(*582*)
	Zephyranthes roseo	Perianth, leaf, and anther.	(*582*)
Berberidaceae	*Berberis vulgaris*		(*370*)

Family	Genus and species	Source	Reference

Chelidonic Acid—Continued

Family	Genus and species	Source	Reference
Campanulaceae	*Centropogon* (6 spp.)		(582)
	Downingia pulchella		(582)
	Isotoma (5 spp.)		(582)
	Laurentia (4 spp.)		(582)
	Lobelia (25 spp.)		(582)
	L. cardinalis		(370)
	L. inflato		(370)
		Fruit	(581)
	L. syphilitica		(370)
	Siphocampylus (9 spp.)		(582)
Cannaceae	*Canna* spp	Root	(581)
Dioscoreaceae	*Discorea balcanica*	Leaf, flower, and pericarp.	(582)
	D. deltoidea	Leaf and flower.	(582)
	D. humifusa	Seed and pericarp.	(582)
Haemodoraceae	*Dilatris corymbosa*	Flower and leaf.	(582)
	Lachenolia tinctoria	do	(582)
	Wachendorfia paniculota	Flower, leaf, and pericarp.	(582)
	W. thyrsiflora	Anther	(582)
Hippocastanaceae	*Aesculus flava*	Perianth and leaf.	(582)
	A. hippocastanum		(581)
Liliaceae	*Acanthocarpus preissii*	Pericarp and leaf.	(582)
	Allium cirrhosum	Leaf	(582)
	A. flavescens	do	(582)
	A. obliquum	do	(582)
	A. tenuissimum	Leaf and flower.	(582)
	Aloe minima	Leaf	(582)
	Androcymbium (3 spp.)		(582)
	Anguillaria dioica	do	(582)
	A. tenella	do	(582)
	Anticlea sibiricus (*Zigadenus sibiricus*).	Leaf, bulb, and filament.	(582)
	Asparagus (11 spp.)		(582)
	A. officinalis		(580)
	Asphodelus clavatus		(582)
	A. damascena		(582)
	Bellevalia dubia (*Hyacinthus dubuis*).	Flower	(582)
	Boemetra columellaris(?)	Filament, leaf, and perianth.	(582)
	Borya septentrionalis	Leaf	(582)
	Brodiaea (3 spp.)		(582)
	Bulbine alooides	Flower	(582)
	Bulbocodium ruthenicum	Leaf	(582)
	B. versicolor	do	(582)
	Chlorophytum bowkeri	Flower	(582)
	C. parviflorum	Pedicel	(582)
	Colchicum (12 spp.)		(582)
	C. autumnale		(370)
	Convallaria majalis		(370)
		Leaf, anther, and perianth.	(582)
	Cordyline banksii	Flower	(582)
	C. pumilio	Leaf	(582)
	Dasylirion graminifolium.	Flower	(582)

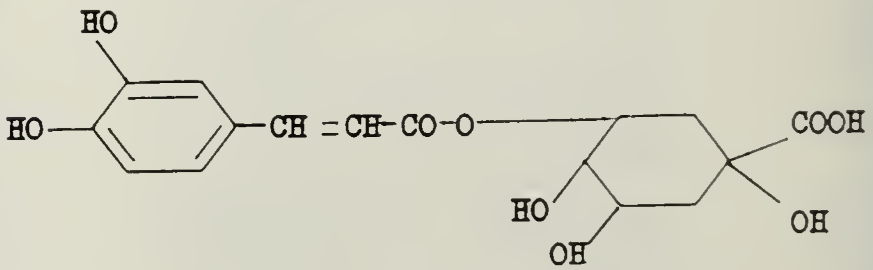
Family	Genus and species	Source	Reference
	Chelidonic Acid—Continued		
Liliaceae	*Dasypogon bromeliifoius*	Flower	*(582)*
	Dichopogon humilis	do	*(582)*
	Dracaena angustifolia	Leaf	*(582)*
	D. elliptica	Flower	*(582)*
	Eremurus himalaicus	Leaf	*(582)*
	Gloriosa superba		*(370, 399)*
	Hookera hyacintha	Flower	*(582)*
	H. minor	do	*(582)*
	Hyacinthus leucophaeus	do	*(582)*
	Iphigenia diuterik(?)	Leaf	*(582)*
	I. indico	do	*(582)*
	Johnsonia lupulina	do	*(582)*
	Kniphofia (4 spp.)		*(582)*
	Lachenalia montigena	Leaf	*(582)*
	L. picta	Leaf and flower.	*(582)*
	Liriope graminifolia	Leaf	*(582)*
	Melonthium tenue	Leaf, perianth, and seed.	*(582)*
	M. virginicum (*M. comosum*).	Leaf and flower.	*(582)*
	Merendera (5 spp.)		*(582)*
	Muscari botryoides	Flower	*(582)*
	M. calandrinianum	Flower and leaf	*(582)*
	Narthecium scardicum	Flower	*(582)*
	Ophiopogon bockianus	Leaf	*(582)*
	O. japonicus	do	*(582)*
	Ornithogalum arabicum	Anther	*(582)*
	O. fimbriatum	Leaf and perianth.	*(582)*
	O. narbonense	Flower	*(582)*
	O. oligophyllum	Pedicel	*(582)*
	Ornithoglossum glaucum	Leaf and flower	*(582)*
	Paradisea liliastrum	Leaf	*(582)*
	Paris bockiana	Leaf and perianth.	*(582)*
	Polygonatum (4 spp.)	do	*(582)*
	Reineckea carnea	Leaf and pedicel.	*(582)*
	Rhipogonum album	Pedicel	*(582)*
	R. scandens	Leaf and pedicel.	*(582)*
	Ruscus hypoglossum	Flower	*(582)*
	Sabadilla officinarum (*Schoenocaulon officinale*).		*(684)*
	Sandersonia aurantiaca	Leaf and perianth.	*(582)*
	Schoenocaulon officinale		*(370)*
	Scilla obtusifolia	Leaf and flower	*(582)*
	S. pratensis	Flower	*(582)*
	S. verna	Leaf	*(582)*
	Smilax (6 spp.)		*(582)*
	Sugerokia orientalis (*Heloniopsis orientalis*).	Leaf, flower, and anther.	*(582)*
	Tofieldia (4 spp.)		*(582)*
	Trichopetalum stellatum (*Bottionea thysantoides*).	Flower	*(582)*
	Trillium (9 spp.)		*(582)*
	Tupistra viridiflora	Leaf	*(582)*
	Urginea maritima		*(370)*
	Uvularia sessilifolia	Leaf and flower	*(582)*

Family	Genus and species	Source	Reference

Chelidonic Acid—Continued

Liliaceae	*Veratrum* (7 spp.)		(582)
	V. album		(370, 637, 684)
	V. viride		(370)
	Wurmbea (4 spp.)		(582)
	Xerotes elongata	Flower	(582)
	X. pauciflora	do	(582)
	X. sauveolens	do	(582)
	Yucca brevifolia	Perianth and pedicel.	(582)
	Zygadenus (5 spp.)		(582)
Papaveraceae	*Chelidonium majus*		(254, 300, 370, 383, 387, 636, 684, 820)
		Leaf	(560)
		Leaf, perianth, and pedicel.	(582)
	Stylophorum diphyllum	Leaf, perianth, and anther.	(582, 632)
Rhamnaceae	*Paliurus aculeatus*	Pedicel	(582)
	Rhamnella franguloides	Leaf	(582)
	Rhamnus (21 spp.)		(582)
	R. cathartica	Fruit	(581)
	Sageretia minutifolia	Leaf	(582)
	Zizyphus lotus	do	(582)
Rubiaceae	*Uragoga ipecacuanha* (*Cephaelis ipecacuanha*).		(370)
Thymelaeaceae	*Daphne* (9 spp.)		(582)
	D. gnidium	Fruit	(581)
	Gnidia (9 spp.)		(582)
	Passerina (5 spp.)		(582)
	Pimelea flava	Leaf	(582)
	Stellera chamaejasme	Leaf and flower	(582)
	Thymelaea (4 spp.)		(582)
	Wikstroemia (3 spp.)		(582)

Chlorogenic Acid



Acanthaceae	*Barleria cristata*		(228)
	Eranthemum macrophyllum.		(228)
	Graptobilanthes hortense (*Graptophyllum hortense*).		(228)
	Strobilanthes lupinus		(228)
	Thunbergia laurifolia		(228)

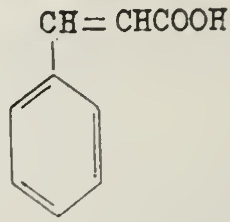
Family	Genus and species	Source	Reference
	Chlorogenic Acid—Continued		
Apocynaceae	*Allamanda hendersonii*		*(228)*
	Alstonia scholaris		*(228)*
	Kopsia flavida		*(228, 231)*
Aquifoliaceae	*Ilex aquifolium*	Leaf, stem, and root.	*(118)*
	I. salicifolia		*(228)*
Araliaceae	*Aralia maculata*		*(228)*
	Hedera helix		*(249)*
	Heptapleurum sp		*(228)*
	Paratropia sp		*(228)*
	Trevesia sundaica		*(228)*
Asclepiadaceae	*Hoya bandanensis*		*(228)*
Bignoniaceae	*Crescentia cuneifloia (C. cujete).*		*(228)*
	Kigelia pinnata		*(228)*
	Spathodea campanulata		*(228)*
Boraginaceae	*Cordia suaveolens*		*(228)*
	Ehretia buxifolia		*(228)*
Cannaceae	*Canna indica*		*(228)*
Caprifoliaceae	*Lonicera* sp		*(228)*
	Sambucus javanica		*(228)*
	S. nigra	Flower	*(118)*
Chenopodiaceae	*Suaeda dodoneifolia*(?)		*(228)*
Compositae	95 genera		*(540)*
	Achillea millefolium	Flower	*(118)*
	Anacyclus pyrethrum	do	*(118)*
	Arnica montana	do	*(118)*
	Centaurea jacea	Leaf	*(118)*
	Cichorium intybus	do	*(118)*
	Clibadium asperum		*(228)*
	C. surinamense		*(228)*
	Dahlia variabilis (D. pinnata).		*(539)*
	Eupatorium javanicum		*(228)*
	E. pallescens		*(228)*
	Gymnanthemum grande		*(228)*
	Helianthus sp	Seed	*(230)*
	H. annuus	do	*(224, 229, 364, 494)*
	H. doronicoides	Leaf	*(118)*
	H. tuberosus		*(536, 538, 539)*
	Lactuca sativa		*(538)*
	Lappa major (Arctium majus).	Leaf	*(118)*
	Pluchea indica		*(228)*
	P. odorata		*(228)*
	Silybum marianum		*(536)*
	Stifftia chrysantha		*(228)*
	Tagetes erecta		*(228)*
	Taraxacum gymnanthum		*(539)*
	Tithonia diversifolia		*(228)*
	Vernonia sp		*(228)*
Convolvulaceae	*Argyreia kurzei*		*(228)*
	Erycibe tomentosa		*(228)*
	Ipomoea batatas		*(228, 538)*
		Root	*(610)*
	Lepistemon flavescens		*(228)*
	Merremia dissecta		*(228)*
	Porana paniculata		*(228)*

Family	Genus and species	Source	Reference
	Chlorogenic Acid—Continued		
Cornaceae	*Mastixia cuspidata*	----------	(*228*)
Cucurbitaceae	*Coccinia cordifolia*	----------	(*228*)
	Trichosanthes sp	----------	(*228*)
Dipsacaceae	*Dipsacus sylvestris*	----------	(*118*)
Ericaceae	*Vaccinium lucidum*	----------	(*228*)
Erythroxylaceae	*Erythroxylon coca*	----------	(*228*)
	E. novogranatense	----------	(*228*)
Eucommiaceae	*Eucommia* sp	Leaf	(*247*)
Gesneriaceae	*Aeschynanthus longiflora*	----------	(*228*)
	Agalmyla staminea	----------	(*228*)
	Cyrtandra bicolor	----------	(*228*)
	Episcia pulchella	----------	(*228*)
	Gloxinia caulescens	----------	(*228*)
	Sinningia sp	----------	(*228*)
Gnetaceae	*Gnetum ovalifolium*	----------	(*228*)
Goodeniaceae	*Scaevola sericea*	----------	(*228*)
Gramineae	Mixed herbage	----------	(*299*)
	Bambusa sp	----------	(*228*)
	Oryza sativa	----------	(*228*)
	Paspalum vaginatum	----------	(*228*)
	Phragmites sp	----------	(*228*)
	Saccharum officinarum	----------	(*228*)
Labiatae	*Ballota foetida*	Leaf	(*118*)
	Calamintha officinalis	----------	(*118*)
	Mentha javanica	----------	(*228*)
	M. rotundifolia	----------	(*118*)
	Salvia coccinea	----------	(*228*)
	S. pratensis	----------	(*118*)
	Stachys lanata	----------	(*118*)
Liliaceae	*Convallaria majalis*	Leaf	(*118*)
Loganiaceae	*Crateriphytum molucanum*	----------	(*228*)
	Strychnos sp	Seed	(*230*)
	S. nux-vomica	----------	(*228*)
		Seed	(*725*)
Magnoliaceae	*Michelia fuscata*	----------	(*228*)
Malvaceae	*Gossypium* sp	----------	(*495*)
Martyniaceae	*Martynia diandra*	----------	(*228*)
Moraceae	*Castilla elastica*	Latex	(*232*)
	Ficus elastica	do	(*232*)
Oleaceae	*Jasminum nudiflorum*	Leaf and flower	(*118*)
Orbanchaceae	*Orobanche epithymum*	Stem	(*118*)
	O. rapum	Stem, flower, and underground parts.	(*118*)
	Phelipaea lutea	----------	(*118*)
Pandanaceae	*Freycinetia strobilacea*	----------	(*228*)
Pedaliaceae	*Sesamum orientale*	----------	(*228*)
Ranunculaceae	*Aconitum septentrionale*	----------	(*315*)
	Clematis paniculata	----------	(*228*)
	C. vitalba	Leaf	(*118*)
	Ranunculus bulbosus	do	(*118*)
Rosaceae	*Crataegus oxyacantha*	Fruit, leaf, and flower.	(*187*)
	Prunus domestica	Fruit	(*147*)
	Pyrus communis	do	(*94, 779*)
		Leaf	(*779*)
	P. malus (*Malus sylvestris*)	Fruit	(*94, 296, 460, 779*)
		Juice	(*530, 531*)
		Leaf	(*788*)

Family	Genus and species	Source	Reference
	Chlorogenic Acid—Continued		
Rubiaceae	*Adina cordifolia*		(*228*)
	Coelospermum corymbosum		(*228*)
	Coffea sp	Bean	(*187, 230, 240, 286*)
	C. arabica		(*228, 593*)
	C. bengalensis		(*228*)
	C. liberica		(*227, 228, 231*)
	Exostemma longiflorum		(*228*)
	Hymenodictyon sp		(*228*)
	Mussaenda officinalis		(*228*)
	Nauclea fagifolia		(*228*)
	Oxyanthus hirsutus		(*228*)
	Palicourea gardenioides		(*228*)
	Timonius compressicaulis		(*228*)
Saxifragaceae	*Hydrangea mutabilis*		(*228*)
Scrophulariaceae	*Capraria biflora*		(*228*)
	Torenia sp		(*228*)
	Veronica alpina	Whole plant	(*118*)
	V. chamaedrys	do	(*118*)
	V. officinalis	do	(*118*)
	V. traversii	Root, stem, and leaf.	(*118*)
Solanaceae	*Atropa belladona*	Leaf	(*537*)
	Brunsfelsia americana	do	(*537*)
	Capsicum annuum (*C. frutescens*).	do	(*537*)
	C. grossum (*C. frutescens*).	do	(*537*)
	C. violaceum	do	(*537*)
	Cestrum aurantiacum	do	(*537*)
	C. elegans	do	(*537*)
	Datura arborea	do	(*537*)
	D. stramonium	do	(*537*)
	Hyoscyamus albus	do	(*537*)
	H. aureus	do	(*537*)
	H. pusillus	do	(*537*)
	H. reticulatus	do	(*537*)
	Mandragora officinarum	do	(*537*)
	Nicotiana sp		(*348*)
	Petunia nyctaginiflora	Leaf	(*537*)
	Physalis alkekengi	do	(*118*)
	P. angulata	do	(*537*)
	P. peruviana	do	(*537*)
	Physochlaina orientalis	do	(*537*)
	Scopolia carniolica	do	(*537*)
	Solanum (16 spp)	do	(*537*)
	S. lycopersicum (*Lycopersicon esculentum*).	do	(*118*)
	S. tuberosum		(*321, 323, 539*)
	Withania frutescens		(*537*)
	W. somnifera		(*537*)
Theaceae	*Thea sinensis*	Leaf	(*602*)
Tiliaceae	*Corchorus olitorius*		(*228*)
Umbelliferae	*Angelica archangelica*	Root	(*690*)
	Apium graveolens		(*539*)
	Eryngium pandanifolium.		(*228*)
	Hydrocotyle sp		(*228*)
	Thapsia garganica		(*539*)
Urticaceae	*Boehmeria nivea*		(*228*)
Verbenaceae	*Verbena officinalis*	Leaf	(*118*)

Family	Genus and species	Source	Reference

Cinnamic Acid



Family	Genus and species	Source	Reference
Compositae	*Parthenium argentatum*	Aqueous extract of root, rubber, resin, and leaf.	(78, 764)
Ericaceae	*Enkianthus japonicus*	Leaf	(166)
Globulariaceae	*Globularia* spp		(264)
	G. alypum	Stalk and leaf	(265)
	G. vulgaris	do	(265, 743)
Hamamelidaceae	*Liquidambar* sp	Resin	(293, 305)
	L. orientalis	do	(718)
	L. styraciflua	do	(304, 717)
Lauraceae	*Cinnamonum* sp	Leaf	(365)
Leguminosae	*Myroxylon pereirae*	Balsam	(212, 268, 356, 361)
	M. toluiferum (*M. balsamum*).	do	(110, 117, 146, 212)
Myrtaceae	*Eugenia jambolana*	Seed	(545)
Scrophulariaceae	*Scrophularia nodosa*	Root	(317)
Styracaceae	*Styrax liquidus* (?)	Resin	(658)

Citramalic Acid

$$\begin{array}{c} COOH \\ | \\ H_3C\text{—}C\text{—}OH \\ | \\ CH_2 \\ | \\ COOH \end{array}$$

Family	Genus and species	Source	Reference
Rosaceae	*Pyrus malus*	Peel	(297, 298)

Citric Acid

$$\begin{array}{c} CH_2COOH \\ | \\ HO\text{—}C\text{—}COOH \\ | \\ CH_2COOH \end{array}$$

Citric acid was first found by Scheele (*626, 627*) in lemons. Franzen and Helwert (*199*) have made a critical review of the literature on occurrence of citric acid, and it appears to be ubiquitous in higher plants.

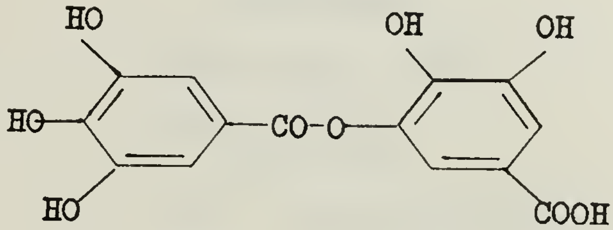
Family	Genus and species	Source	Reference

Coumaric Acid

$$HOC_6H_4CH{=}CHCOOH$$

Bignoniaceae	*Catalpa bignonioides*	Leaf	(*462*)
	C. ovata	Leaf and bark	(*282*)
Leguminosae	*Daviesia latifolia*	Leaf and stem	(*555*)
	Melilotus alba	Vegetative part.	(*99*)
		Root	(*616*)
	M. officinalis	Vegetative part.	(*99*)
	Trifolium pratense	Flower	(*553*)
Papaveraceae	*Papaver somniferum*		(*635*)
Pinaceae	*Pinus* sp	Resin	(*37*)
Rosaceae	*Prunus serotina*	Bark	(*550*)

Digallic Acid



Theaceae	*Thea sinensis*	Leaf	(*601, 602*)

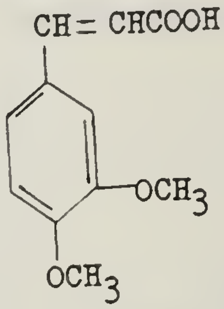
Dihydroxymaleic Acid

$$\begin{array}{c} HO{-}C{-}COOH \\ \| \\ HO{-}C{-}COOH \end{array}$$

Papaveraceae	*Glaucium luteum*	Pressed juice	(*634*)

Family	Genus and species	Source	Reference

3,4-Dimethoxycinnamic Acid



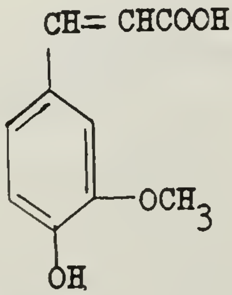
Scrophylariaceae	*Veronica virginica*	Rhizome and root.	*(552)*

Ethylmalic Acid

$$\begin{array}{l} CH_3CH_2\text{—}CH\text{—}COOH \\ \qquad\quad\;\; | \\ \qquad HO\text{—}CH\text{—}COOH \end{array}$$

Euphorbiaceae	*Euphorbia biglandulosa*	Latex	*(342)*

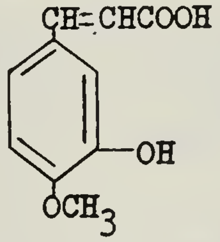
Ferulic Acid



Bignoniaceae	*Catalpa ovata*	Bark	*(282)*
Pinaceae	*Larix europaea (L. decidua).*	Resin	*(37)*
Umbelliferae	*Ferula assafoetida*	Resin of roots and rhizomes.	*(638)*

Family	Genus and species	Source	Reference

Isoferulic Acid



Bignoniaceae	*Catalpa ovata*	Root bark	(*282*)
Ranunculaceae	*Cimicifuga racemosa*	Rhizome	(*188*)

Fluoracetic Acid

CH_2FCOOH

Dichapetalaceae	*Dichapetalum cymosum*	----------	(*425*)

Fumaric Acid

H—C—COOH
‖
HOOC—C—C—H

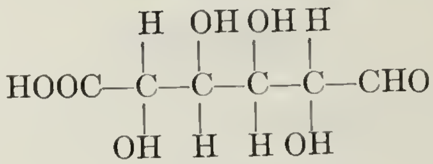
Aceraceae	*Acer saccharum*	Sirup	(*468*)
		Sugar sand	(*469*)
		Sap and sirup	(*542*)
Asclepiadaceae	*Asclepias syriaca*	Root	(*427*)
Chenopodiaceae	*Beta vulgaris*	Diffusion juice	(*501, 673*)
Compositae	*Helianthus annuus*	----------	(*58*)
Cruciferae	*Bunias orientalis*	Stem, leaf, and flowering top.	(*316*)
Eucommiaceae	*Eucommia ulmoides*	Leaf	(*246*)
Euphorbiaceae	*Cluytia similis*	Leaf and stem	(*729*)
	Ricinus communis	Germinating bean.	(*145*)
Gramineae	*Hordeum vulgare*	Leaf	(*114*)
		Etiolated shoot	(*168*)
		Seedling	(*314*)
	Oryza sativa	Grain	(*256*)
		Leaf	(*809*)
	Saccharum officinarum	Juice	(*603, 604, 605*)
	Sorghum sp	Sirup	(*416*)

Family	Genus and species	Source	Reference

Fumaric Acid—Continued

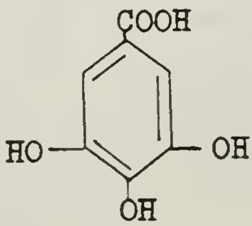
Labiatae	*Salvia officinalis*	Leaf	*(96)*
Leguminosae	*Daviesio latifolia*	Leaf and stem	*(555)*
	Phaseolus coccineus		*(58)*
	P. mungo		*(129)*
Papaveraceae	*Corydolis bulbosa*		*(781)*
	Fumaria officinalis	Sap	*(138, 140, 713, 790)*
	Glaucium flovium	Leaf	*(486)*
	G. luteum		*(560, 561, 634)*
	Papover somniferum		*(635)*
Solanaceae	*Nicotiana* sp		*(653, 748, 749)*
Umbelliferae	*Daucus carolo*	Root tissue	*(105, 106, 409)*
	Myrrhis odorata	Leaf	*(308, 486)*

Galacturonic Acid



Rosaceae	*Frogaria vesca*	Juice	*(447, 448)*
	Prunus persica	do	*(18)*
		Fruit	*(19)*
	Pyrus communis	Fruit	*(19, 29)*
	P. malus (Malus sylvestris).	Juice	*(530)*

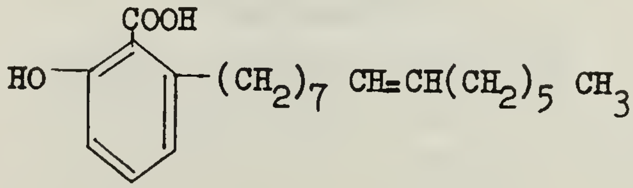
Gallic Acid



Anacardiaceae	*Rhus coriaria*	Stalk	*(386, 677)*
	R. glabra	Fruit	*(618)*
	R. semiolata	do	*(734)*
Celastraceae	*Celastrus scandens*	do	*(776)*
Commelinaceae	*Commelina agraria*		*(594)*
Cornaceae	*Cornus florida*	Flower and bract.	*(619)*
	C. sericeo	Fruit pulp	*(679)*

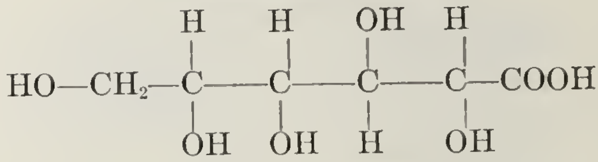
Family	Genus and species	Source	Reference
	Gallic Acid—Continued		
Ericaceae	*Arctostophylos uvaursi*		*(607)*
	Epigaea repens		*(502)*
Euphorbiaceae	*Phyllonthus distichus*	Root bark	*(136)*
Fagaceae	*Quercus aegilops*	Acorn	*(677)*
	Q. pedunculota (Q. robur).	Wood	*(442)*
Geraniaceae	*Geranium onoei*		*(301)*
	G. pratense		*(91)*
	G. zonale		*(93)*
Lauraceae	*Persea gratissima (P. americana).*	Fruit kernel	*(514, 515)*
Leguminosae	*Pithocellobium saman (Samanea saman).*	Bark	*(307)*
Loganiaceae	*Gelsemium sempervirens*	Root	*(289)*
Musaceae	*Musa paradisiaca*	Sap	*(263)*
Myrtaceae	*Psidium* spp		*(515)*
Nymphaeaceae	*Brasenia schreberi*		*(461)*
Oleaceae	*Olea europea*	Leaf	*(115)*
Polygonaceae	*Rheum austriocum*	Root	*(273)*
	R. rhaponticum	do	*(273)*
Punicaceae	*Punica granatum*	Root bark	*(772, p. 641, note 1)*
Rubiaceae	*Coffea* sp		*(529)*
Sapotaceae	*Mimusops* sp		*(515)*
Scrophulariaceae	*Digatalis* sp		*(88, p. 776)*
	D. purpurea		*(88, p. 776)*
Simarubaceae	*Quassia simaruba*	Root bark	*(772, p. 641, note 1)*
Solanaceae	*Nicotiana tabacum*	Leaf	*(772, p. 1112, note 2)*
Theaceae	*Thea sinensis*		*(369, 601, 602)*

Ginkgolic Acid



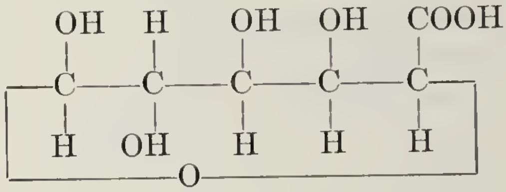
Ginkgoaceae	*Ginkgo biloba*	Fruit	*(334)*

Gluconic Acid



Family	Genus and species	Source	Reference
Chenopodiaceae	*Beta vulgaris*	Crust on juice preheater.	*(402)*

Glucuronic Acid



Family	Genus and species	Source	Reference
Compositae	*Taraxacum officinale*	Young leaf	*(504)*
Cucurbitaceae	*Cucurbita pepo*	Seed	*(504)*
Gramineae	*Hordeum vulgare*	Germinating seed.	*(504)*
	Musa sp	Shoot	*(621)*
Leguminosae	*Phaseolus* or *Vicia*	Germinating seed and etiolated leaf.	*(504)*

Glutaric Acid

$$HOOC—CH_2—CH_2—CH_2—COOH$$

Family	Genus and species	Source	Reference
Chenopodiaceae	*Beta vulgaris*	Beet	*(395, 396, 742)*

Glyceric Acid

$$CH_2OH—CH(OH)—COOH$$

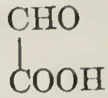
Family	Genus and species	Source	Reference
Chenopodiaceae	*Beta vulgaris*	Diffusion juice	*(673)*
Gramineae	*Hordeum vulgare*		*(56)*
		Leaf	*(57, 114)*
Leguminosae	*Glycine* sp	Leaf	*(24)*
Solanaceae	*Nicotiana tabacum*		*(687)*

Glycolic Acid

HO—CH_2—COOH

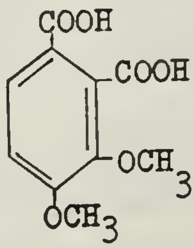
Family	Genus and species	Source	Reference
Caprifoliaceae	*Sambucus nigra*	Leaf	*(34)*
Caryophyllaceae	*Herniaria glabra*	do	*(34)*
Chenopodiaceae	*Beta vulgaris*	Beet juice	*(396, 501, 672, 673)*
Combretaceae	*Combretum micranthum*	Leaf	*(34)*
Compositae	*Cynara scolymus*	do	*(34)*
	Solidago virga-aurea	Flowering twig	*(34)*
Dichapetalaceae	*Dichapetalum cymosum*		*(425)*
Ericaceae	*Arbutus unedo*	Leaf	*(34)*
	Erica multiflora	Flowering twig	*(34)*
Euphorbiaceae	*Ricinus communis*		*(65, 145)*
Gramineae	*Agropyron repens*	Root and rhizome.	*(34)*
	Avena sativa	Seedling	*(291)*
	Hordeum vulgare		*(56, 57)*
		Leaf	*(114, 687)*
		Etiolated shoot	*(168)*
		Seedling	*(291)*
	Saccharum officinarum	Juice	*(559, 603, 604, 605, 654, 686)*
	Zea mays	Stigmata	*(34)*
Labiatae	*Lavandula vera*	Flowering twig	*(34)*
	Orthosiphon stamineus	Leaf	*(34)*
	Rosmarinus spp	Flowering twig	*(34)*
Leguminosae	*Lupinus albus*	Seedling	*(291)*
	Medicago sativa	Sap	*(185)*
	Pisum sativum	Seedling	*(291)*
Liliaceae	*Asparagus* spp	Root and rhizome.	*(34)*
	Ruscus aculeatus	do	*(34)*
Pinaceae	*Juniperus communis*	Berry	*(34)*
Rosaceae	*Prunus cerasus*	Peduncle	*(34)*
	Pyrus communis	Juice	*(592)*
	P. malus (Malus sylvestris).	do	*(700)*
			(686)
Solanaceae	*Nicotiana tabacum*	Leaf	*(687)*
	Physalis alkekengi	Berry	*(34)*
	Solanum lycopersicum (Lycopersicon esculentum).	Leaf	*(686, 687)*
Umbelliferae	*Apium graveolons*	Root and rhizome.	*(34)*
	Eryngium campestre	do	*(34)*
	Foeniculum vulgare	do	*(34)*
	Petroselinum sativum (P. crispum).	do	*(34)*
Urticaceae	*Parietaria* spp	Leaf	*(34)*
Vitaceae	*Ampelopsis hederacea (Parthenocissus quinquefolia.)*	do	*(235)*
	Vitis vinifera	Unripe fruit	*(101, 183, 184)*
		Fruit	*(280)*

Glyoxalic Acid



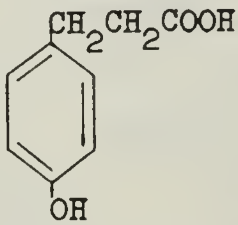
Family	Genus and species	Source	Reference
Chenopodiaceae	*Beta vulgaris*		*(396)*
Cornaceae	*Cornus mas*	Fruit	*(631)*
Ericaceae	*Vaccinium oxycoccos*		*(682)*
Gramineae	*Saccharum officinarum*	Juice	*(784)*
Labiatae	*Mentha piperita*	Leaf	*(709, 711)*
Leguminosae	*Arachis hypogaea*	Seedling	*(195, 196)*
Liliaceae	*Tulipa gesneriana*		*(709, 710)*
Polygonaceae	*Rheum officinale*		*(102)*
Rosaceae	*Prunus domestica*	Unripe fruit	*(102)*
	Pyrus malus (Malus sylvestris).	do	*(102)*
		Fruit	*(298)*
Saxifragaceae	*Ribes* sp.	Unripe fruit	*(102)*
	R. grossularia	do	*(102)*
Solanaceae	*Solanum tuberosum*	Tuber	*(711)*
Umbelliferae	*Daucus carota*	Leaf and root	*(709)*
		Root	*(711)*
Vitaceae	*Vitis vinifera*		*(102, 103, 248, 280)*
		Juice	*(647)*

Hemipinic Acid



Family	Genus and species	Source	Reference
Papaveraceae	*Papaver somniferum*		*(635)*

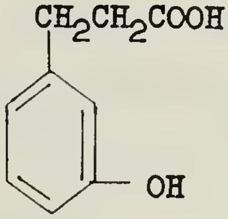
Hydrocaffeic Acid



Family	Genus and species	Source	Reference
Chenopodiaceae	*Beta vulgaris*	Leaf	*(397)*
Solanaceae	*Solanum tuberosum*	Tuber	*(587)*
Vitaceae	*Ampelopsis hederacea (Parthenocissus quinquefolia).*		*(587)*

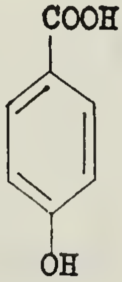
Family	Genus and species	Source	Reference

Hydrocoumaric Acid



Leguminosae-----	*Melilotus officinalis*-----	--------------	*(822)*

p-Hydroxybenzoic Acid



Bignoniaceae-----	*Bignonia catalpa*--------	Unripe fruit----	*(534)*
	Catalpa ovata-----------	Leaf----------	*(462)*
Papaveraceae----	*Papaver somniferum*-----	---------------	*(635)*

Hydroxycitric Acid

$$\begin{array}{l} \quad\;\; CH_2\text{—}COOH \\ \qquad | \\ HO\text{—}C\text{—}COOH \\ \qquad | \\ HO\text{—}C\text{—}COOH \\ \qquad | \\ \quad\;\; H \end{array}$$

Chenopodiaceae--	*Beta vulgaris*-----------	Juice----------	*(395)*

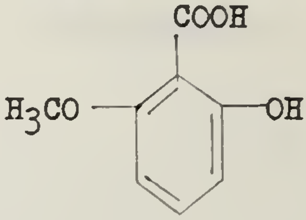
alpha-Hydroxyglutaric Acid

$$HOOC\text{—}CH_2CH_2CHOH\text{—}COOH$$

henopodiaceae--	*Beta vulgaris*-----------	Sap-----------	*(394)*

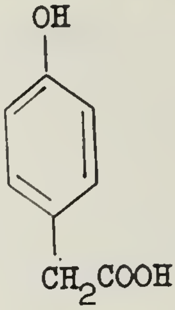
Family	Genus and species	Source	Reference

2-Hydroxy-6-Methoxybenzoic Acid



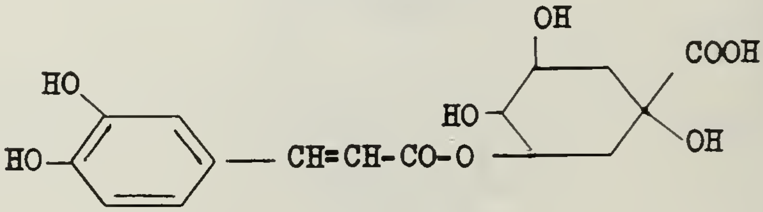
Liliaceae	*Gloriosa superba*	Tuber	*(123)*

p-Hydroxyphenylacetic Acid



Compositae	*Taraxacum officinale*	Root	*(546)*

Isochlorogenic Acid



Rosaceae	*Pyrus communis*	Leaf and shoot	*(94)*
		Leaf	*(788)*
Rubiaceae	*Coffea* sp		*(41)*

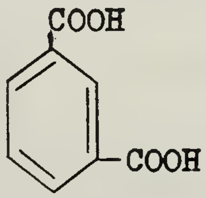
Family	Genus and species	Source	Reference

Isocitric Acid

$$\begin{array}{l} CH(OH)—COOH \\ | \\ CH—COOH \\ | \\ CH_2—COOH \end{array}$$

Family	Genus and species	Source	Reference
Anonaceae	*Anona muricata*		(*479*)
Crassulaceae	*Bryophyllum* sp	Leaf	(*80, 505, 572*)
	B. calycinum	do	(*109, 362, 563, 564, 566, 568, 686, 687, 738, 747*).
		Leaf and stem	(*567*)
	Escheveria sp	Leaf	(*362*)
	E. secunda		(*484, 485*)
	Sedum acre		(*485*)
	S. maximum		(*485*)
	S. praealtum		(*803*)
	Sempervivum tectorum		(*485*)
Gramineae	*Hordeum vulgare*		(*56*)
		Leaf	(*57, 589*)
Lecythidaceae	*Couroupita guianensis*	Fruit	(*476*)
Leguminosae	*Pisum sativum*	Ungerminated seeds.	(*424*)
Rosaceae	*Pyrus malus* (*Malus sylvestris*).	Fruit	(*105, 106*)
	Rubus fruticosus	do	(*127, 465, 470*)
Scrophulariaceae	*Digitalis purpurea*		(*331*)
		Leaf	(*362*)
Solanaceae	*Nicotiana tabacum*		(*686*)
		Leaf	(*687*)
	Solanum lycopersicum (*Lycopersicon esculentum*).	Leaf	(*686, 687*)
	S. tuberosum	Juice of tuber	(*126*)
Umbelliferae	*Daucus carota*		(*105, 106*)

Isophthalic Acid



Family	Genus and species	Source	Reference
Iridaceae	*Iris versicolor*	Rhizome	(*554*)

alpha-Ketoadipic Acid

$$HOOC—CH_2—CH_2—CH_2—CO—COOH$$

Family	Genus and species	Source	Reference
Leguminosae	*Pisum sativum*	Germinating seed.	(*753*)

Family	Genus and species	Source	Reference

alpha-Ketoglutaric Acid

$$HOOC—CH_2—CH_2—CO—COOH$$

Family	Genus and species	Source	Reference
Euphorbiaceae	*Ricinis communis*	Germinating seed.	*(145)*
Gramineae	*Hordeum vulgare*	Etiolated shoot	*(168)*
Labiatae	*Mentha piperito*	Leaf	*(709, 711)*
Leguminosae	*Arachis hygogaea*	Seedling	*(195, 196)*
	Pisum sativum	Young plant	*(757, 759)*
	Trifolium pratense		*(756, 757)*
Liliaceae	*Tulipa gesneriana*		*(709, 710)*
Rosaceae	*Pyrus malus (Malus sylvestris).*	Fruit	*(298)*
Solanaceae	*Solanum tuberosum*	Tuber	*(38, 711)*
Umbelliferae	*Daucus carota*	Root and leaf	*(709)*
		Root	*(711)*

Lactic Acid

$$CH_3—CHOH—COOH$$

Family	Genus and species	Source	Reference
Amaryllidaceae	*Agave sisalana*	Leaf	*(414, 640, 641)*
Bromeliaceae	*Ananas sativas (A. comosus).*		*(515)*
Chenopodiaceae	*Beta vulgaris*		*(438)*
		Juice	*(672, 673)*
		Root	*(680, 681)*
		Root and leaf	*(742)*
Compositae	*Helicnthus annuus*		*(58)*
	Lactuca sp		*(515)*
		Leaf	*(640)*
	L. sativa	Leaf	*(641)*
Crassulaceae	*Bryophyllum calycinum*		*(801)*
Cruciferae	*Brassica oleracea*	Fresh and fermented kale.	*(42)*
		Cabbage leaf	*(641)*
Cucurbitaceae	*Cucumis sativus*		*(680)*
Ericaceae	*Vaccinium myrtillus*		*(325)*
Euphorbiaceae	*Ricinis communis*		*(137)*
		Germinating seed.	*(145, 294)*
		Seedling	*(640)*
		Seedling and leaf.	*(641)*
Fagaceae	*Castanea vesca (C. sativa)*	Fruit	*(148)*
	Fagus sylvatica	Nut	*(327)*
Gentianaceae	*Erythraca centaurium*		*(253)*
Gramineae	*Bambusa* sp	Shoot	*(621)*
	Hordeum distichum	Germinating seed.	*(681)*
	H. sativum		*(793)*
	H. vulgare	Etiolated shoot	*(168)*
	Oryza spp	Leaf	*(809)*
	Secale cereale	do	*(668)*
	Triticum sativum (T. aestivum).	do	*(668)*
	T. vulgare	Germinating seed.	*(681)*
	Zea mays	do	*(640, 641, 793)*

Family	Genus and species	Source	Reference
Lactic Acid—Continued			
Leguminosae	*Glycine* sp		*(327)*
	Lupinus sp	Seed	*(456)*
	L. luteus	Germinating seed.	*(681)*
	Phaseolus coccineus		*(58)*
	P. vulgaris	Seedling	*(641)*
	Pisum sativum	Germinating seed.	*(640, 641, 681)*
	Tamarindus indico		*(3, 325)*
	Vicia faba	Leaf and sprout	*(640, 641)*
		Germinating seed.	*(681)*
Malvaceae	*Gossypium* sp	Seed	*(327)*
Myricaceae	*Myrica rubra*	Fruit	*(354)*
Myrsinaceae	*Maesa picta*	Seed	*(22)*
Papaveraceae	*Glaucium luteum*	Pressed juice	*(634)*
	Papaver somniferum	"Poppy straw"	*(635)*
Polygonaceae	*Rheum* sp	Leaf	*(640)*
	R. hybridum	Tuber	*(641)*
Rosaceae	*Eriobotrya japonica*	Milky juice	*(128, p. 93, ftn. 12)*
	Fragaria sp	Juice of fruit	*(281)*
	Prunus avium		*(197)*
	P. cerasus	Juice of fruit	*(437)*
	Pyrus communis	do	*(437)*
		Juice and fruit	*(592)*
	P. malus (Malus sylvestris).	Fruit	*(200, 281)*
		Juice of fruit	*(436, 437, 702)*
	Rubus sp	Leaf	*(640)*
	R. fruticosus	do	*(203, 204, 641)*
	R. idaeus	do	*(210, 211, 642)*
Rutaceae	*Citrus decumana (C. grandis).*	Juice of fruit	*(281)*
Salicaceae	*Salix* sp	Bark	*(151)*
Scrophulariaceae	*Digatalis purpurea*		*(331)*
	Euphrasia officinalis		*(172)*
	Veronica officinalis		*(171)*
Solanaceae	*Solanum dulcamara*	Peduncle	*(800)*
	S. lycopersicum (Lycopersicon esculentum).	Fruit	*(109, 116, 737)*
		Juice of fruit	*(595)*
	S. tuberosum	Tuber	*(39, 40, 640, 641, 680, 681, 778, 793)*
Sterculiaceae	*Theobroma cacao*	Seed	*(453)*
Umbelliferae	*Daucus carota*		*(640)*
		Root	*(641, 681)*
Vitaceae	*Vitis vinifera*	Juice	*(437)*
		Sap	*(799)*

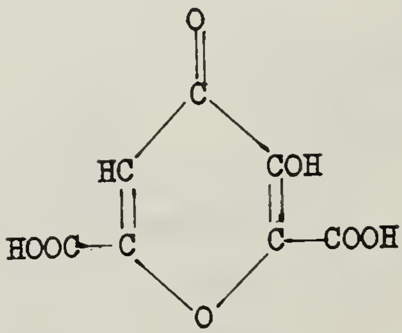
Malic Acid

COOH
|
CHOH
|
CH_2COOH

Malic acid was discovered by Scheele (*628*), who reported its presence in a number of plants. Franzen and Keyssner (*204*) have made a critical review of the literature on its occurrence, but it appears to be ubiquitous in higher plants.

Family	Genus and species	Source	Reference
	Malonic Acid		
	COOH | CH_2COOH		
Chenopodiaceae	*Beta vulgaris*	Incrustation on evaporator.	*(393)*
		Juice	*(395)*
		Beet and leaf	*(742)*
Compositae	*Helianthus annuus*		*(58)*
	H. tuberosus		*(226)*
Cruciferae	*Bunias orientalis*	Stem, leaf, and flowering top.	*(316)*
Gramineae	Mixed herbage		*(299)*
	Avena sativa		*(291, 474)*
	Dactylis glomerata		*(134)*
	Hordeum vulgare		*(291, 474)*
	Triticum sp		*(473)*
Leguminosae	*Anthyllis* sp		*(58)*
	Astragalus sp		*(58)*
	A. sinicus		*(812)*
	Colutea sp		*(58)*
	Lotus sp		*(58)*
	Lupinus sp		*(58, 291)*
	Medicago sp		*(58)*
	M. sativa		*(727)*
	Melilotus sp		*(58)*
	Ononis sp		*(58)*
	Phaseolus coccineus		*(58)*
	Sophora sp		*(58)*
	Thermopsis sp		*(58)*
	Trifolium sp		*(58)*
	Trigonella sp		*(58)*
	Vicia sp		*(58)*
Rosaceae	*Fragaria* sp	Fruit	*(683)*
Umbelliferae	*Anthriscus* sp		*(58)*
	Apium sp		*(58)*

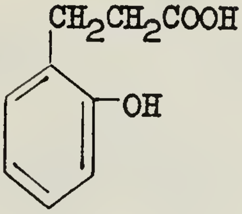
Meconic Acid



Family	Genus and species	Source	Reference
Papaveraceae	*Papaver rhoeas*		*(510)*
	P. somniferum		*(66)*
		Dried capsules	*(141)*
		Milky sap	*(1, p. 1337, ftn. 1)*

Family	Genus and species	Source	Reference

Melilotic Acid



Leguminosae	*Melilotus alba*	Vegetative part	*(99)*
	M. officinalis	do	*(99, 822)*
Solanaceae	*Nicotiana tabacum*	Leaf	*(772, p. 1112, note 2)*

Mesaconic Acid

$$\begin{array}{l} \quad\;\; CH_3—C—COOH \\ \qquad\qquad \| \\ HOOC—CH \end{array}$$

Bignoniaceae	*Crescentia* sp.	Curare	*(330)*
Cruciferae	*Brassica oleracea*	Leaf	*(111, 112)*
Gramineae	*Saccharum officinarum*	Juice	*(603, 604, 605)*

Mesoxalic Acid

$$(HO)_2C\begin{cases} COOH \\ COOH \end{cases}$$

Leguminosae	*Medicago sativa*		*(185)*

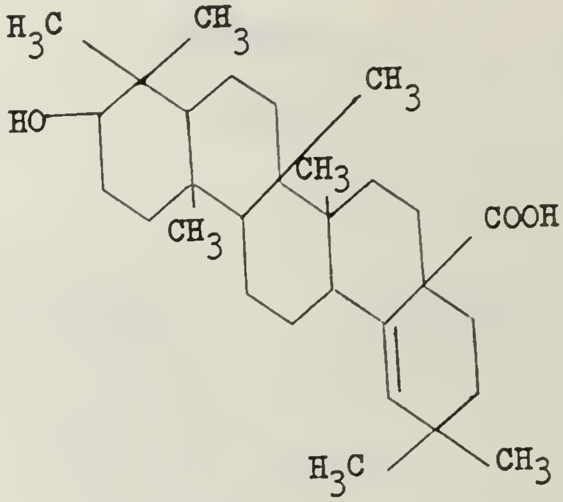
gamma-Methylene-alpha-Ketoglutaric Acid

$$\begin{array}{c} HOOC—\underset{\underset{CH_2}{\|}}{C}—CH_2\underset{\underset{O}{\|}}{C}—COOH \end{array}$$

Leguminosae	*Arachis hypogaea*	Seedling	*(195, 196)*
Liliaceae	*Tulipa gesneriana*		*(709, 710)*

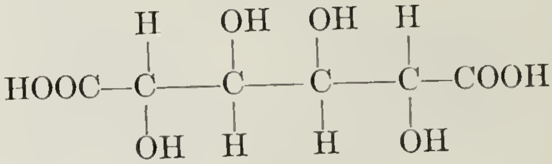
Family	Genus and species	Source	Reference

Morolic Acid



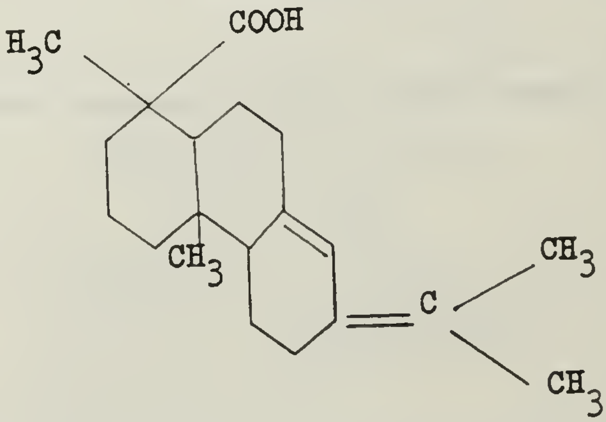
Family	Genus and species	Source	Reference
Ericaceae	*Agauria salicifolia*	----------------	*(158)*

Mucic Acid



Family	Genus and species	Source	Reference
Chenopodiaceae	*Beta vulgaris*	Diffusion juice	*(672)*
Elaeocarpaceae	*Elaeocarpus serratus*	Fruit pulp	*(870)*
Rosaceae	*Prunus persica*	Ripe fruit	*(19)*
	Pyrus communis	do	*(19)*

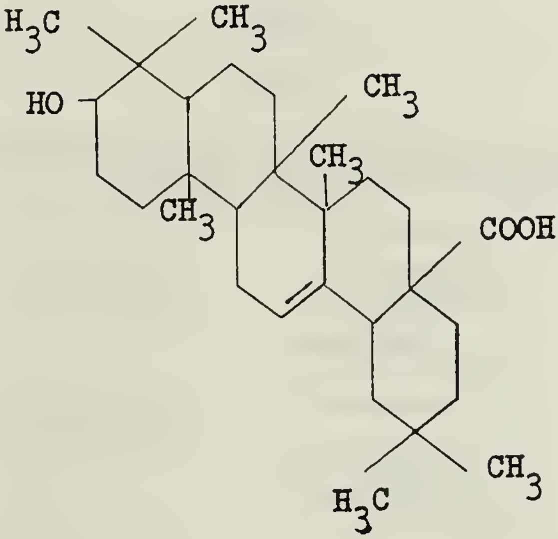
Neoabietic Acid



Family	Genus and species	Source	Reference
Pinaceae	*Pinus palustris*	Oleoresin	*(258)*
	P. sylvestris	Oleoresin and wood resin.	*(259)*

Family	Genus and species	Source	Reference

Oleanolic Acid



Family	Genus and species	Source	Reference
Apocynaceae	*Alyxia buxifolia*	Bark	(*21*)
Ericaceae	*Vaccinium myrtillus*		(*583*)
Euphorbiaceae	*Petalostigma sericeum*		(*21*)
Labiatae	*Salvia officinalis*		(*97*)
	Thymus vulgaris		(*609*)
Loranthaceae	*Viscum album*	Leaf	(*795*)
Myrtaceae	*Psidium guajava*	do	(*27*)
Oleaceae	*Olea europea*	do	(*252*)
Rosaceae	*Crataegus oxyacantha*	do	(*60*)
	Eriobotrya japonica	do	(*26*)
Solanaceae	*Anthocercis intricata*	Bark	(*21*)
	A. littorea	do	(*21*)
	A. odgersii	do	(*21*)
Vitaceae	*Vitis labrusca*	Pomace	(*432*)

Oxalacetic Acid

HOOC—CH_2—CO—COOH

Gramineae	*Hordeum vulgare*		(*756*)
	Phleum pratense		(*756*)
Labiatae	*Mentha piperita*		(*709, 711*)
Leguminosae	*Canvalia ensiformis*		(*756*)
	Pisum sativum		(*755, 756, 757, 758, 759*)
	Trifolius pratense	Young leaf	(*754, 755, 756, 757*)
Liliaceae	*Tulipa gesneriana*		(*709, 710*)
Rosaceae	*Pyrus malus* (*Malus sylvestris*).	Fruit	(*298*)
Solanaceae	*Solanum tuberosum*	Tuber	(*711*)
Umbelliferae	*Daucus carota*	Root and leaf	(*709*)
		Root	(*711*)

Family	Genus and species	Source	Reference

Oxalic Acid

$$\begin{array}{c} \mathrm{COOH} \\ | \\ \mathrm{COOH} \end{array}$$

[Reviews and surveys of the occurrence of oxalic acid include those of Andrews and Viser (*17*), Esbach (*475, p. 1909*), Kohman (*350, 351*), Meyen (*443, p. 122*), Miller, Ross, and Lewis (*446*), Molisch (*450*), Patschovsky (*508*), Schimper (*630*), and Treviranus (*128, p. 66, note 6*)]

Family	Genus and species	Source	Reference
Aceraceae	*Acer platanoides*	Root	(*359*)
	A. saccharum	Sap and sugar sand.	(*768*)
Aizoaceae	*Mesembryanthemum* sp.		(*509*)
	M. acinaciforme		(*2*)
	M. crystallinum		(*16, 63*)
		Leaf and flower	(*62*)
Amarantaceae			(*509*)
	Alternanthera sessilis		(*292*)
	Amaranthus sp.		(*236*)
	A. aquatica (?)		(*622*)
	A. caudatus		(*62*)
		Leaf and flower	(*63*)
	A. gangeticus		(*292*)
	A. polygonoides		(*292*)
Amaryllidaceae	*Agave americana*	Leaf	(*815*)
Anacardiaceae	*Mangifera indica*		(*86*)
Araceae	*Acorus calamus*		(*810*)
	Arum italicum	Berry	(*343*)
Aristolochiaceae	*Asarum* sp.		(*509*)
Balsaminaceae	*Impatiens parviflora*		(*455*)
	I. sultani		(*455*)
Begoniaceae	*Begonia* sp.		(*220*)
	B. evansiana		(*650, 651, 652*)
	B. rex		(*760*)
	B. semperflorens		(*125, 611, 732*)
Berberidaceae	*Berberis vulgaris*	Fruit	(*343*)
Betulaceae	*Alnus* sp.	Leaf	(*771*)
	Betula sp.		(*359*)
	Ostrya vulgaris		(*359*)
Bombacaceae	*Adansonia digitata*	Fruit	(*5*)
Bromelianceae	*Bromolia pinguin*	do	(*28*)
Cactaceae			(*509*)
	Cereus peruvianus		(*728*)
	Opuntia sp.		(*478*)
	O. vulgaris	Stem	(*343*)
Caprifoliaceae	*Sambucus nigra*	Young leaf	(*47*)
	Symphoricarpos sp.	Leaf	(*771*)
Caryophyllaceae	*Dianthus babatus*		(*492*)
	D. carthusianorum	Leaf and stem	(*12*)
	Lychnis coronaria		(*74*)
	L. dioica		(*12, 74, 91*)
	L. flos-jovis		(*74*)
	L. githago (*Agrostemma githago*).		(*12*)
	Saponaria sp.		(*478*)
	S. officinalis		(*12*)
	Spergula arvensis		(*74*)
	Stellaria media		(*455, 492*)
	Tunica saxifraga		(*12*)
Celastraceae	*Celastrus obscurus*	Leaf	(*154*)
	Euonymus japonicus		(*2*)

Family	Genus and species	Source	Reference

Oxalic Acid—Continued

Family	Genus and species	Source	Reference
Chenopodiaceae			(446)
	Atriplex sp		(509)
	Beta vulgaris		(492, 509, 533, 622)
		Juice	(396, 444, 501, 672, 673)
		Root and leaf	(418, 742)
		Leaf	(33, 454, 615, 624)
		Swiss chard, mangold, and beet leaf.	(625)
		Seed	(149, 685)
		Root	(23, 226, 236, 773)
	Chenopodium sp		(509)
	C. quinoa	Leaf and flower	(62, 63)
	Halogeton glomeratus		(191, 290)
	Spinacia oleracea		(23, 90, 381, 475, 509, 533)
		Leaf	(46, 69, 150, 236, 492, 615, 782, 910)
Commelinaceae	*Callisia repens*		(455)
	Tradescantia sp		(509)
	T. fluminesis		(53, 777)
	T. selloi	Leaf	(630)
	T. virginica	do	(343)
Compositae	*Cichorium endivia*		(23)
	Helianthus tuberosus		(226)
	Kleinia articulata		(312)
	Lactuca spp		(515)
	L. sativa		(475, 633, 782)
Convolvulaceae	*Ipomoea aquatica*		(292)
Cornaceae	*Cornus sericea*	Fruit pulp	(679)
rassulaceae	*Bryophyllum calycinum*	Leaf	(109, 563, 568, 573, 686, 687, 738)
		Leaf and stem	(567)
	B. crenatum	Leaf	(80, 343)
	Echeveria glauca	do	(343)
	Sedum azureum		(16)
	S. fabaria	Leaf	(343)
	Sempervivum glaucum	do	(52)
	S. tectorum	do	(343)
ruciferae			(509)
	Brassica oleracea		(23, 475)
	B. pekinensis		(810)
	Bunias orientalis	Stem, leaf, and flowering top.	(316)
ucurbitaceae	*Cucumis melo*		(23, 533)
	Cucurbita pepo		(782)
ipsacaceae	*Succisa pratensis*		(492)
ricaceae	*Vaccinium myrtillus*		(23, 325)
uphorbiaceae	*Aleurites cordata*	Leaf	(221)
	Euphorbia sp		(509)
	Mercurialis annuelle		(130)
	M. perennis		(492)
	Phyllanthus emblica		(326)
	Ricinus communis		(65)
agaceae	*Fagus sylvatica*		(95, 492, 646)
	Quercus pedunculata		(442)

Oxalic Acid—Continued

Family	Genus and species	Source	Reference
Gesneraceae	*Aeschynanthus* sp		(*509*)
Globulariaceae	*Globularia* spp		(*264*)
Gramineae			(*509*)
	Avena sativa	Seedling	(*291, 474, 524*)
	Bambusa sp	Shoot	(*621*)
	Hordeum vulgare	Leaf	(*47, 687*)
		Seedling	(*291, 314, 474, 686*)
	Lolium perenne		(*420*)
	Oplismenus imbecillis (*O. undulatifolius*).		(*53*)
	Oryza spp	Leaf	(*809*)
	Phyllostachys mitis	Sprout	(*695*)
	Poa pratensis		(*533*)
	Saccharum officinarum	Juice	(*85; 512; 603; 604; 605; 699; 704, ref. 162; 811*)
	Secale cereale		(*474*)
	Sorghum sp	Juice	(*416*)
	S. vulgare		(*786, 787*)
		Leaf	(*802*)
	Triticum sp		(*473*)
	T. aestivum		(*533*)
	Zea mays		(*53, 761*)
Hippocastanaceae	*Aesculus hippocastanum*	Young leaf	(*47*)
Hydrocharitaceae	*Elodea canadensis*		(*459*)
	E. densa		(*459*)
Juglandaceae	*Juglans rexia*	Bark	(*353*)
Labiatae			(*509*)
Leguminosae	*Acacia* spp	Bark	(*675*)
	Acacia cambagei	Bark and wood	(*674, 675*)
	Arachis hypogaea	Kernel	(*585*)
	Cassia sp	Leaf	(*763*)
	Cicer arietinum	Secretion from hairs.	(*449*)
		Fruit	(*818*)
	Glycine soja (*G. max*)		(*533*)
	Lupinus albus	Seedling	(*291*)
	L. luteus	Seed	(*600*)
	Medicago sativa		(*533*)
	Mimosa speggazzinii		(*455*)
	Phaseolus limensis (*P. lunatus*).		(*533*)
	Pisum sativum	Seedling	(*291, 533, 782*)
	Tamarindus indica		(*202, 325, 326*)
		Mature leaf	(*237*)
	Vicia sp		(*318, 336*)
	Vicia faba		(*23*)
Liliaceae			(*509*)
	Agapanthus umbellatus	Leaf	(*343*)
	Allium cepa		(*8; 77, p. 165, ref. 4; 360, 782*)
	Asparagus officinalis		(*23*)
	Erythronium denscanis	Bulb	(*153*)
	Hyacinthus orientalis	do	(*75*)
	Smilacina bifolia(?)	Fruit	(*163*)
	S. racemosa	do	(*163*)
Loranthaceae	*Viscum* sp		(*509*)
Malvaceae	*Gossypium* sp		(*180, 181, 182, 412*)

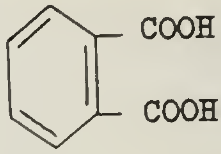
Family	Genus and species	Source	Reference
	Oxalic Acid—Continued		
Melastomaceae	*Memecylon tinctorium*		*(155)*
Menispermaceae	*Jateorhiza columba*		*(724)*
Moraceae	*Cannabis* sp		*(130)*
	Ficus carica		*(236)*
Musaceae	*Musa sapientum* (*M. paradisiaca sapientum*).	Overripe fruit	*(482)*
Myricaceae	*Myrica rubra*	Fruit	*(354)*
Myristicaceae	*Myristica surinamensis*	Seed	*(715)*
Myrtaceae	*Eucalyptus* (12 spp.)	Bark	*(665)*
	Psidium guajava	Leaf	*(10)*
Nyctaginaceae	*Mirabilis* sp	Flower and fruit	*(535)*
Nymphaeaceae	*Nymphaea alba*	Rhizome	*(244)*
	N. lutea	do	*(244)*
Orchidaceae			*(509)*
	Vanilla planifolia		*(767)*
Oxalidaceae	*Averrhoa carambola*		*(120)*
		Fruit	*(385)*
		Juice	*(472)*
	Oxalis sp		*(220, 236, 509)*
	O. acetosella	Leaf	*(343, 429)*
	O. corniculata		*(237)*
	O. stricta		*(63)*
	O. violacea		*(515)*
Papaveraceae			*(509)*
	Fumaria officinalis	Seedcoat	*(238)*
Pedaliaceae	*Sesamum indicum*	Seed	*(262)*
Phytolaccaceae	*Phytolacca* sp		*(509)*
	P. dioica	Shoot, bark, and pith.	*(2)*
Pinaceae			*(608)*
	Pinus abies (*Picea abies*)	Sap	*(324, 646)*
	P. cembra	Seedling	*(644)*
	P. excelsa (*Picea abies*)	Needle	*(492, 813)*
Piperaceae	*Peperomia* sp		*(509)*
olygonaceae	*Emex* sp		*(509)*
	Fagopyrum esculentum		*(53, 533)*
		Leaf and stem	*(577)*
	Oxyria sp		*(509)*
	Polygonum sp		*(509)*
	Rheum sp		*(23, 104, 236, 381, 509, 750, 782)*
		Leaf	*(676)*
	R. crispum(?)	Stem	*(499)*
	R. hybridum	Leaf and rhizome.	*(9)*
		Leaf	*(565, 576, 687, 760)*
		Stem and rhizome.	*(612, 613)*
	R. leucorrhizum	Stem	*(499)*
	R. nepalense	do	*(499)*
	R. nutans	do	*(499)*
	R. officinale	Leaf	*(102, 760)*
	R. palmatum	Stem	*(499)*
	R. "Paragon"	do	*(499)*
	R. rhaponticum	do	*(375)*
	R. undulatum	Petiole	*(343)*
	Rumex sp		*(220, 236, 509)*
	R. acetosa	Leaf	*(45)*
		Seed and root	*(63)*
			(23, p. 99, ftn. 2; 61; 515)
	R. obtusifolius	Root	*(359)*

Family	Genus and species	Source	Reference
	Oxalic Acid—Continued		
Polypodiaceae	*Lonchitis* sp		*(509)*
Portulacaceae	*Portulaca* sp		*(236, 509)*
	Talinum speciosum		*(292)*
Primulaceae			*(509)*
	Primula elatior		*(492)*
Punicaceae	*Punica granatum*		*(326)*
		Bark	*(478)*
Pyrolaceae	*Monotropa* sp		*(509)*
Ranunculaceae	*Anemone* sp		*(509)*
	A. nemorosa		*(732)*
Rhamnaceae	*Rhamnus lycioides*	Leaf	*(77, p. 165, ref. 4)*
	Zizyphus jujuba		*(326)*
Rosaceae	*Crataegus* sp	Leaf	*(771)*
	C. oxyacantha	do	*(47)*
	Fragaria sp		*(6)*
		Fruit	*(23, 782)*
	Mespilus germanica	Overripe fruit	*(482)*
	Prunus armeniaca	Dried fruit	*(464)*
	P. avium	Fruit	*(197)*
	P. cerasus	do	*(23, 337)*
	P. domestica	do	*(23, 104)*
	P. persica	do	*(23)*
	Pyrus communis	do	*(23)*
		Overripe fruit	*(482)*
	P. malus (*Malus sylvestris*).	Fruit	*(23, 200, 298, 726)*
	Quillaja sp		*(478)*
	Rubus sp	Fruit	*(23, 782)*
	R. fruticosus	Leaf	*(205)*
		Fruit	*(465)*
	R. idaeus		*(732)*
Rubiaceae	*Cinchona* spp	Bark	*(284, 586)*
	Coffea sp	Seed	*(46)*
	C. arabica	Fruit capsule	*(270)*
	Dentella asiatica		*(292)*
	Galium lucidum	Leaf	*(343)*
Rutaceae	*Citrus aurantium*	Fruit	*(23, 482, 782)*
		Leaf	*(660)*
		Peel	*(659)*
	C. decumana (*C. grandis*)	Fruit	*(326, 439)*
		Peel	*(659)*
	C. limon	Fruit	*(23, 326, 482, 782)*
		Peel	*(659)*
	C. medica	Petiole	*(77, p. 165, ref. 4)*
		Fruit	*(326)*
	C. nobilis (*C. reticulata*)	Fruit	*(482)*
Santalaceae	*Santalum album*		*(309)*
Saxifragaceae	*Ribes grossularia*		*(23, 104, 782)*
	R. rubrum		*(198)*
	R. sanguineum		*(358)*
Simarubaceae	*Quassia amara*	Root bark	*(772, p. 641 note 1)*

Family	Genus and species	Source	Reference
	Oxalic Acid—Continued		
Solanaceae	----------	----------	*(130)*
	Capsicum annuum (*C. frutescens*).	----------	*(23, 63, 236)*
	Datura sp	----------	*(509)*
	D. stramonium	----------	*(455)*
	Nicotiana sp	Leaf	*(30, 493, 505, 569, 574, 575, 662, 748, 749, 805)*
		----------	*(32, 686, 707, 708, 751)*
	N. tabacum	Leaf	*(455; 687; 772, p. 1112, note 2)*
	Solanum sp	----------	*(509)*
	S. lycopersicum (*Lycopersicon esculentum*).	----------	*(4, 63, 122, 533, 686, 810)*
		Fruit	*(7, 23, 104, 351, 381, 782)*
		Unripe fruit	*(83, 84)*
	S. tuberosum	Tuber	*(23, p. 99, ftn. 2; 126; 303; 426; 455; 562; 656; 782)*
Sterculiaceae	*Sterculia plantanifolia* (*Firmiana simplex*).	----------	*(8)*
	Theobroma cacao	----------	*(23, 236, 452, 453, 782)*
Theaceae	----------	----------	*(236, 292, 785)*
Umbelliferae	----------	----------	*(509)*
	Angelica archangelica	Root	*(690)*
	Anethum graveolens	Leaf	*(782)*
	Apium graveolens	----------	*(23)*
	Pastinaca sativa	----------	*(782)*
	Petroselinum sativum (*P. crispum*).	----------	*(782)*
Valerianaceae	*Valeriana officinalis*	----------	*(91)*
	Valerianella sp	----------	*(509)*
Vitaceae	*Ampelopsis* sp	----------	*(509)*
	A. quinquefolia (*Parthenocissus quinquefolia*).	Fruit	*(557)*
	Vitis vinifera	----do	*(23, 184, 186, 276)*
		----------	*(278, 280)*
		Leaf and fruit	*(343)*
		Leaf and shoot	*(479)*
		Sap	*(480, 804)*
		Vines	*(481)*
Zingiberaceae	*Hedychium* sp	Leaf	*(77, p. 165, ref. 4)*
Zygophyllaceae	*Guaiacum* sp	Phloem	*(77, p. 165, ref. 4)*

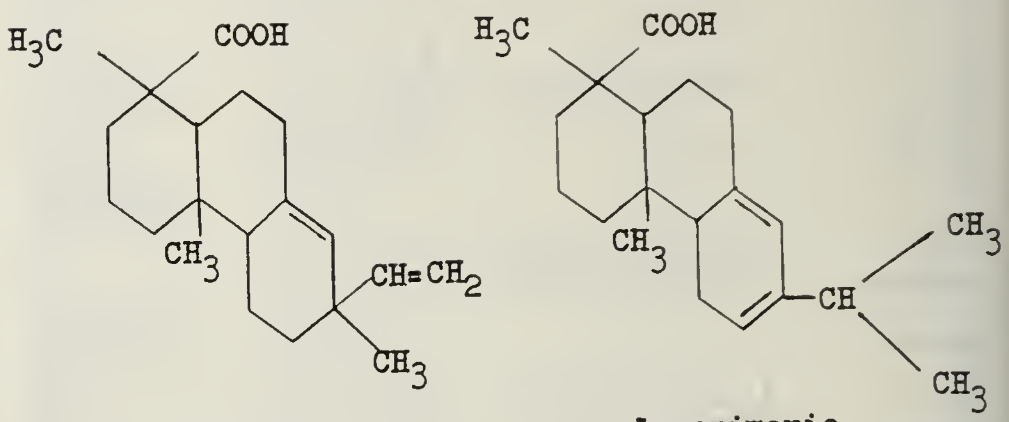
Family	Genus and species	Source	Reference

Phthalic Acid



Papaveraceae	*Papaver somniferum*	-------------	(*635*)

Pimaric Acid



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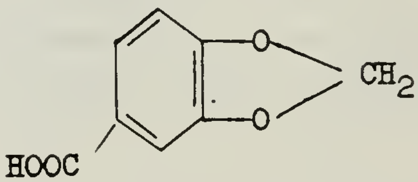
Pinaceae	*Picea vulgaris* (*P. abies*)	Resin	(*67*)
	P. excelsa (*P. abies*)	do	(*260, 345, 346*)
	Pinus (5 spp.)	Oleoresin	(*260*)
	P. maritima	Resin	(*157, 378*)
	P. palustris	Oleoresin	(*35, 257*)
		Resin	(*357*)
		Turpentine gum.	(*503*)
	P. pinaster	-------------	(*159*)
	P. sylvestris	-------------	(*259, 274*)

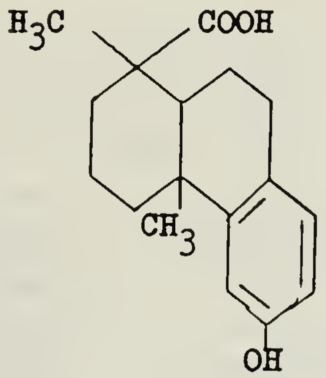
Piperonilic Acid



Rubiaceae	*Palicourea densiflora*	Bark	(*318*)

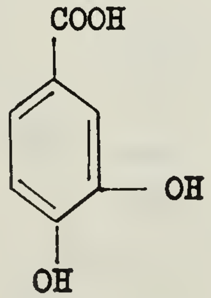
Family	Genus and species	Source	Reference

Podocarpic Acid



Pinaceae	Dacrydium cupressinum		(161, 649)
	Podocarpus cupressina		(500, 649)
	P. dacrydioides		(161, 649)

Protocatechuic Acid



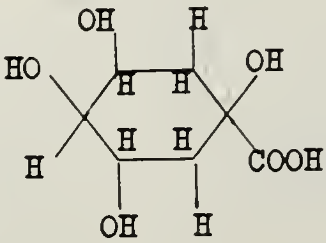
Bignoniaceae	*Crescentia* sp	Crude curare	(330, 783)
Globulariaceae	*Globularia alypum*		(743)
Liliaceae	*Allium cepa*	Skin	(20, 389, 390, 762)
Magnoliaceae	*Illicium anisatum*	Fruit and seed	(498)
	I. religiosum	Fruit	(121, 164, 165)
	I. verum	Capsule	(76)
Saxifragaceae	*Hydrangea thunbergii* (*H. serrata*).	Leaf	(698)
Vitaceae	*Vitis vinifera*	do	(73)

Pyruvic Acid

$$\begin{array}{c} CH_3 \\ | \\ C{=}O \\ | \\ COOH \end{array}$$

Family	Genus and species	Source	Reference
Chenopodiaceae	*Spinacia oleracea*	Leaf	*(31)*
Euphorbiaceae	*Ricinus communis*	Germinating seed.	*(145)*
Gramineae	*Hordeum vulgare*		*(57)*
		Seedling	*(314)*
Labiatae	*Mentha piperita*	Leaf	*(709, 711)*
Leguminosae	*Arachis hypogaea*	Seedling	*(195, 196)*
	Pisum sativum	Leaf	*(31)*
		Seedling	*(759)*
			(757)
	Trifolium pratense		*(757)*
Liliaceae	*Allium cepa*		*(55)*
		Juice	*(451)*
	Tulipa gesneriana		*(709, 710)*
Rosaceae	*Pyrus malus (Malus sylvestris).*	Fruit	*(298)*
Solanaceae	*Solanum tuberosum*	Tuber	*(38, 711)*
Umbelliferae	*Daucus carota*	Leaf and root	*(709)*
		Root	*(711)*

Quinic Acid



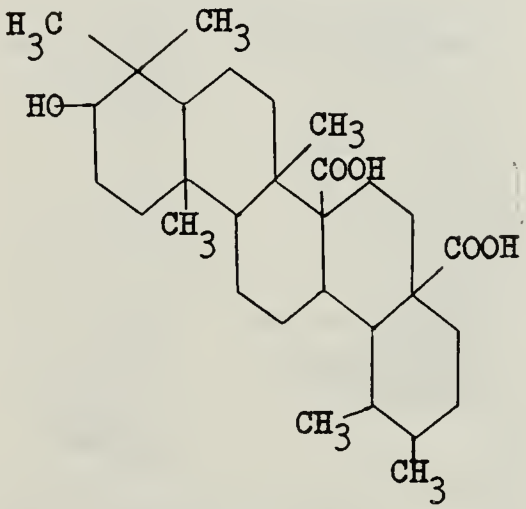
Family	Genus and species	Source	Reference
Compositae	*Taraxacum officinale*		*(404)*
Ericaceae	*Vaccinium arctostaphylos*	Leaf	*(670)*
	V. myrtillus		*(325)*
		Young leaf	*(341)*
		Foliage	*(821)*
	V. oxycoccos	Fruit	*(352, 379)*
	V. vitis-idaea	Leaf	*(328)*
Gramineae		Hay	*(403, 404)*
	Mixed herbage		*(299)*
Leguminosae	*Tamarindus indica*	Fruit	*(325)*
Magnoliaceae	*Illicium verum*	Capsule	*(76)*
Pinaceae	*Cedrus libani*	Needle	*(701)*
	Larix europaea (L. decidua).	do	*(701)*
	Picea excelsa (P. abies)	Young shoot	*(340)*
			(341)
Ranunculaceae	*Aconitum septentrionale*		*(315)*

Family	Genus and species	Source	Reference

Quinic Acid—Continued

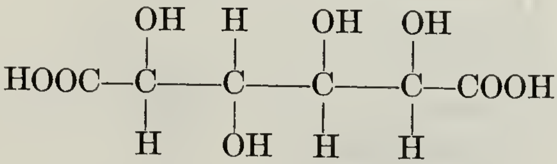
Family	Genus and species	Source	Reference
Rosaceae	*Prunus domestica*	Ripe fruit	*(147)*
		Fruit	*(352)*
	P. persica	Fruit	*(18, 133)*
	Pyrus communis	Juice	*(592)*
		Fruit	*(733)*
	P. malus (Malus sylvestris).	Fruit	*(295, 298)*
		Juice	*(530, 531, 700)*
Rubiaceae	*Cinchona* sp		*(284, 287, 521, 522, 586, 741)*
	C. cordifolia		*(522)*
	Coffea sp	Fruit	*(823)*
	Gallium mollugo		*(490)*
Solanaceae	*Nicotiana tabacum*	Leaf	*(772, p. 1112, note 2)*
Umbelliferae	*Angelica archangelica*	Root	*(690)*
Vitaceae	*Vitis vinifera*	Fruit	*(352)*

Quinovic Acid



Family	Genus and species	Source	Reference
Rosaceae	*Potentilla*	Root	*(589)*
Rubiaceae	*Cinchona* spp		*(284, 586, 614)*
Zygophyllaceae	*Zygophyllum coccineum*		*(669)*

Saccharic Acid



Family	Genus and species	Source	Reference
Moraceae	*Ficus elastica*	Latex	*(232)*

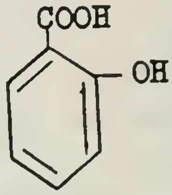
Family	Genus and species	Source	Reference

Saccharinic Acid

$$CH_2OH—CHOH—CHOH—C(CH_3)(OH)—COOH$$

Family	Genus and species	Source	Reference
Bromeliaceae	*Ananas sativas* (*A. comosus*).	Fruit	(*79*)

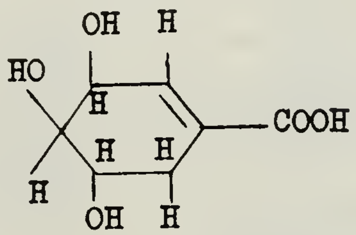
Salicylic Acid



Family	Genus and species	Source	Reference
Compositae	*Calendula officinalis*		(*143*)
	Matricaria chamomilla	Flower head	(*548*)
Euphorbiaceae	*Cluytia similis*	Stem and leaf	(*729*)
Iridaceae	*Iris versicolor*	Rhizome	(*554*)
Leguminosae	*Daviesia latifolia*	Leaf and stem	(*555*)
	Glycyrrhiza glabra	Root	(*142*)
	Trifolium pratense	Flower	(*535*)
Liliaceae	*Aloe* sp		(*731*)
	Gloriosa superba	Tuber	(*123*)
	Hyocinthus sp		(*241*)
	Tulipa sp		(*241*)
	Yucco sp		(*241*)
Moraceae	*Morus* sp	Fruit	(*142*)
Pittosporaceae	*Pittosporum undulotum*	do	(*556*)
Polygalaceae	*Polygala* sp	Root	(*639*)
Ranunculaceae	*Cimicifuga racemosa*	Rhizome	(*188*)
Resedaceae	*Reseda odorata*		(*421*)
Rosaceae	*Fragaria* sp	Calyx and pedicel.	(*435*)
		Fruit	(*543, 544, 712, 735*)
		Fruit pulp and juice.	(*689*)
		Juice	(*791*)
	Prunus armenica	Fruit	(*712*)
	P. avium	do	(*143*)
	P. cerasus	do	(*142, 143, 243, 712*)
		Juice	(*311*)
	P. domestico	Fruit	(*712*)
	P. persica	do	(*712*)
	Rubus fruticosus	do	(*712*)
	R. idoeus	do	(*243, 712, 735*)
		Juice	(*266, 791*)
	R. occidentalis	Fruit	(*712*)
	Spiraea ulmaria (*Filipendula ulmoria*).	Flower	(*421, 422*)
Rubiaceae	*Uragoga ipecocuanha* (*Cephaelis ipecacuanha*).	Root	(*421*)
Rutaceae	*Barosma* sp		(*770*)
	Casimiroa edulis	Seed	(*549*)
Saxfragaceae	*Ribes* sp	Fruit	(*712*)

Family	Genus and species	Source	Reference
	Salicylic Acid—Continued		
Solaneaceae	*Solanum lycopersicum* (*Lycopersicon esculentum*.		(*194, 519*)
Violaceae	*Viola* (6 spp.)		(*143*)
	V. syrtica	Leaf, stem, and rhizome.	(*423*)
	V. tricolor	Flower, leaf, stem, and root.	(*242*)
		Leaf, stem, and rhizome.	(*423*)
Vitaceae	*Vitis labrusca*	Fruit	(*243*)
	V. vinifera	do	(*435*)

Shikimic Acid



Family	Genus and species	Source	Reference
Ginkgoaceae	*Ginkgo biloba*	Leaf	(*261, 808*)
Gramineae	*Lolium perenne*		(*596*)
Magnoliaceae	*Illicium anisatum*		(*498*)
	I. religiosum	Fruit	(*121, 164*)
			(*165*)
		Carpel	(*655*)
	I. verum		(*76, 213*)
		Carpel	(*655*)
Pinaceae	25 spp		(*261*)
Taxaceae	4 spp		(*261*)

Succinic Acid

COOH
|
CH_2
|
CH_2
|
COOH

Franzen and Ostertag (*208*) have made a critical review of the literature on the occurrence of succinic acid.]

Family	Genus and species	Source	Reference
Aceraceae	*Acer saccharum*	Sirup	(*468, 542*)
		Sugar sand	(*469*)
Amaryllidaceae	*Narcissus poeticus*	Leaf and root	(*752*)
Begoniaceae	*Begonia semperflorens*		(*611, 732*)
Betulaceae	*Corylus* sp	Nut	(*144*)
Bigononiaceae	*Crescentia* sp		(*72*)
		Crude curare	(*330*)

Succinic Acid—Continued

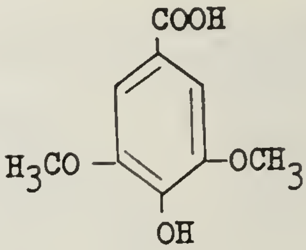
Family	Genus and species	Source	Reference
Bombacaceae	*Adansonia digitata*	Fruit	*(5)*
Celastraceae	*Goupia tomentosa*	Wood	*(156)*
Chenopodiaceae	*Beta vulgaris*	Juice	*(396, 501, 672, 673)*
		Top and root	*(571)*
		Leaf and root	*(742)*
	Spinacia oleracea	Leaf	*(377)*
Compositae	*Artemisia absinthium*		*(706)*
		Leaf	*(819)*
	Helianthus annuus		*(58)*
	Lactuca spp		*(515)*
	L. sativa		*(347, 732)*
	L. virosa		*(347)*
	Taraxacum officinale		*(404)*
Crassulaceae	*Bryophyllum* sp	Leaf	*(570, 571)*
	B. calycinum	do	*(109, 563, 687)*
		Detached leaf	*(738)*
			(686)
	Echeveria secunda		*(207)*
		Leaf	*(484)*
	Sedum acre	Leaf	*(484)*
	Sempervivum glaucum	do	*(52)*
Cruciferae	*Brassica olerocea*	Leaf and bud	*(475)*
	Bunias orientalis	Stem, leaf, and flowering top.	*(316)*
Ericaceae	*Vaccinium myrtillus*	Fruit	*(325)*
		Whole plant	*(583)*
Euphorbiaceae	*Ricinus communis*		*(65, 145)*
Fagaceae	*Fagus sylvatica*	Sap	*(646)*
	Quercus sp	Nut	*(144)*
Gramineae			*(299)*
	Avena sativa		*(291)*
	Bambusa sp		*(70)*
	Dactylis glomerata		*(134)*
	Hordeum vulgare	Leaf	*(114, 687)*
		Etiolated shoot	*(168)*
		Seedling	*(291, 686)*
			(314, 739)
	Lolium perenne		*(134)*
	Oryza spp		*(809)*
	O. sativa		*(256)*
	Phleum pratense		*(134)*
	Saccharum officinarum	Juice	*(68, ref. 57; 603; 604; 605; 704, ref. 162; 794; 811)*
	Triticum sp		*(739)*
	Zea mays	Leaf	*(43, 571)*
Juglandaceae	*Juglans regia*	Nut	*(144)*
Lauraceae	*Persea gratissima* (*P. americana*).	Kernel	*(514)*
Leguminosae	*Lupinus albus*	Seedling	*(291)*
	Phaseolus coccineus		*(58)*
	Pisum sativum	Seedling	*(291)*
	Tamarindus indica		*(202, 325)*
Loganiaceae	*Strychnos toxifera*		*(70, 71)*
Malvaceae	*Gossypium* sp		*(181)*
Moraceae	*Morus* sp		*(806)*
	M. alba	Bark exudate	*(225)*
	M. indica	Leaf	*(326)*
Musaceae	*Musa basjoo*	Juice	*(623)*
	M. sapientum	Fruit	*(193)*

Succinic Acid—Continued

Family	Genus and species	Source	Reference
Papaveraceae	*Chelidonium majus*		*(636)*
	Eschscholtzia sp		*(766)*
	Glaucium luteum	Juice	*(634)*
	Papaver somniferum		*(766)*
Pinaceae		Turpentine	*(380)*
	Abies pectinata (*A. alba*).	do	*(113)*
		Resin	*(722)*
	Agathis australis	Resin	*(457)*
	A. dammara	do	*(719)*
	Larix decidua	do	*(723)*
	Picea vulgaris (*P. abies*)	do	*(720)*
	Pinus sp	Sap	*(646)*
	P. sylvestris	Resin	*(721)*
Polygonaceae	*Fagopyrum esculentum*		*(144)*
		Leaf and stem	*(571)*
	Rheum hybridum	Rhizome and stem.	*(612)*
		Leaf	*(687)*
	R. officinale	Petiole	*(102)*
	R. rhaponticum	Leaf and petiole	*(571)*
	R. undulatum	Petiole	*(343)*
Proteaceae	*Orites excelsa*	Wood	*(664)*
Ranunculaceae	*Anemone nemorosa*	Leaf	*(400)*
			(732)
Rosaceae	*Fragaria* sp	Fruit	*(6)*
	Prunus avium	do	*(197)*
	P. cerasus	Juice	*(319)*
		Fruit	*(337)*
	P. communis	Fruit pulp	*(320)*
	P. persica	Fruit	*(18)*
	Pyrus aucuparia (*Sorbus aucuparia*).	do	*(206)*
			(401)
	P. communis	Juice	*(592)*
		Fruit	*(733)*
	P. malus (*Malus sylvestris*).	Fruit	*(43,105,106)*
			(200)
		Juice	*(530, 702)*
	Rubus fruticosus	Leaf	*(205)*
		Fruit	*(465)*
	R. idaeus	Leaf	*(211, 319, 732)*
Rutaceae	*Citrus limon*	Fruit	*(326)*
Santalaceae	*Santalum album*		*(309)*
Sapotaceae	*Mimusops* sp		*(515)*
Saxifragaceae	*Ribes rubrum*		*(198)*
Scrophulariaceae	*Digitalis purpurea*		*(87, 331)*
Solanaceae	*Atropa bellodonna*		*(366)*
	Nicotiana sp		*(43, 571, 653, 686)*
		Leaf	*(570, 748, 749)*
	N. tabacum	Leaf	*(687, 751)*
	Solanum lycopersicum (*Lycopersicon esculentum*).	Fruit	*(7, 736, 737)*
		Overripe fruit	*(82, 83, 84)*
		Leaf and stalk	*(571)*
		Leaf	*(686, 687)*
	S. tuberosum	Tuber	*(814)*
Umbelliferae	*Angelica archangelica*	Root	*(690)*
	Daucus carota	do	*(105, 106, 409)*
Vitaceae	*Vitis vinifera*	Leaf	*(73)*
		Unripe fruit	*(101)*
		Fruit	*(102, 343)*
		Sap and fruit	*(280)*
		Sap	*(481, 804)*

Family	Genus and species	Source	Reference

Syringic Acid



Family	Genus and species	Source	Reference
Gramineae	*Saccharum officinarum*	Juice	(*605*)
		Crude molasses	(*696*)

Tartaric Acid

COOH
|
CHOH
|
CHOH
|
COOH

[Franzen and Helwert (*201*) have made a critical review of literature on the occurrence of tartaric acid]

Family	Genus and species	Source	Reference
Aceraceae	*Acer saccharum*	Sugar sand	(*398, 666*)
		Sirup	(*469*)
Amaryllidaceae	*Agave americana*	Leaf sap	(*107*)
Anacardiaceae	*Mangifera indica*		(*86*)
	Rhus coriaria		(*152*)
	R. semialata		(*734*)
	Spondias purpurea		(*558*)
Araliaceae	*Aralia hispida*	Fruit	(*222*)
Ascelpiadaceae	*Asclepias syriaca*	Milky sap	(*643*)
Berberidaceae	*Berberis integerrima*	Fruit	(*343*)
	Caulophyllum thalictroides.	Fruit pulp	(*679*)
Betulaceae	*Betula alba*	Sap	(*217*)
Bombacaceae	*Adansonia* sp	Fruit	(*445*)
		Fruit pulp	(*523, p. 779*)
	A. digitata	Fruit	(*5*)
Bromeliaceae	*Ananas sativas* (*A. comosus*).	do	(*79, 515*)
Caprifoliaceae	*Diervilla florida*	Fruit	(*135*)
	Lonicera xylosteum	do	(*170*)
	Sambucus callicarpa	do	(*124*)
	S. ebulus	do	(*174*)
		Root	(*175*)
	S. nigra	Fruit	(*173*)
	Symphoricarpos racemosus (*S. albus*).	do	(*663*)
	Viburnum lantana		(*178*)
	V. nudum		(*406*)
Caricaceae	*Carica papaya*	Fruit	(*513*)
Celastraceae	*Celastrus obscurus*	Leaf	(*154*)
	C. scandens	Fruit	(*776*)
	Euonymus atropurpureus	Root bark	(*463*)
	E. europaeus	Seed kernel	(*245*)

Family	Genus and species	Source	Reference

Tartaric Acid—Continued

Family	Genus and species	Source	Reference
Chenopodiaceae	*Beta vulgaris*	Root	*(226, 396)*
		Root and leaf	*(742)*
	Chenopodium ambrosioides		*(201, p. 297)*
Commelinaceae	*Tradescantia purpurea*	Stem sap	*(219)*
	T. zebrina (Zebrina pendula).	do	*(219)*
Compositae	*Bellis perennis*		*(179)*
	Helianthus tuberosus	Tuber	*(92, 226)*
	Matricaria chamomilla	Flower	*(269)*
Cornaceae	*Cornus paniculatum (C. racemosus).*	Fruit	*(648)*
	C. sericea	do	*(679)*
Cruciferae	*Capella bursapastoris*		*(131)*
Elaegnaceae	*Hippophae rhamnoides*	Fruit	*(797)*
Elaeocarpaceae	*Elaeocarpus serratus*	do	*(807)*
Ericaceae	*Vaccinium* sp	Leaf	*(328)*
	V. corymbosum	Fruit	*(257)*
	V. vitisidaea	Leaf	*(491)*
		Fruit	*(792)*
Eucommiaceae	*Eucommia ulmoides*	Leaf	*(246)*
Euphorbiaceae	*Euphorbia cyparissias*	Milky sap	*(774)*
	E. platyphylla	do	*(775)*
	Phyllanthus emblica		*(326)*
	Ricinus communis		*(65)*
Fagaceae	*Quercus pedunculata (Q. robur).*	Wood	*(442)*
Geraniaceae	*Geranium zonale*		*(93)*
Gramineae	*Bambusa* sp	Shoot	*(621)*
	Saccharum officinarum	Juice	*(811)*
	Sorghum vulgare		*(416, 786, 787)*
Guttiferae	*Garcinia gambogia*	Fruit rind	*(367)*
Hydnoraceae	*Prosopanche burmeisteri*		*(816)*
Labiatae	*Glechoma hederacea*		*(176)*
	Orthosiphon stamineus		*(338)*
Lauraceae	*Persea gratissima (P. americana).*	Fruit pulp	*(514, 515)*
Leguminosae	*Astragalus* sp	Twig	*(408)*
	Bauhinia reticulata	Fruit and leaf	*(578)*
	Cassia sp	Leaf	*(716, 763)*
	C. acutifolia	do	*(376)*
	Tamarindus indica	Fruit pulp	*(81, 590, 688, 746)*
			(3; 192; 201, ref. 28; 202; 233; 740)
		Leaf	*(237)*
		Mesocarp	*(271)*
		Green and ripe fruit.	*(310, 558)*
		Fruit	*(326, 693)*
Liliaceae	*Clintonia borealis*	Fruit	*(661)*
	Erythronium denscanis	Bulb	*(153)*
	Smilacina bifolia (?)	Fruit	*(163)*
	S. racemosa	do	*(163)*
Magnoliaceae	*Schizandra chinensis*	do	*(525)*
Moraceae	*Morus indica*	Leaf	*(326)*
Myrtaceae	*Eugenia australis*		*(407)*
	Psidium guajava		*(620)*
Musaceae	*Musa sapientum*	Fruit	*(193)*
Orchidaceae	*Vanilla planifolia*	do	*(384)*
Oxalidaceae	*Oxalis corniculata*	Leaf	*(237)*

Tartaric Acid—Continued

Family	Genus and species	Source	Reference
Papaveraceae	*Adlumia cirrhosa* (*A. fungosa*).	Root	(*633*)
	Chelidonium majus	Leaf	(*560*)
	Fumaria officinalis	Sap	(*201, p 295*)
	Papaver somniferum	Capsule	(*141*)
Pinaceae	*Pinus sylvestris*	Pollen	(*363*)
Piperaceae	*Piper nigrum*		(*520*)
Polygonaceae	*Polygonum reynoutria*	Stem	(*697*)
Ranunculaceae	*Aconitum napellus*		(*588*)
Rosaceae	*Crataegus* sp	Fruit	(*433*)
	Cydonia vulgaris	do	(*119, 693, 714*)
	Eriobotrya japonica	do	(*368*)
	Fragaria sp		(*119, 458, 714*)
	Prunus armeniaca	Fruit	(*119, 487, 489, 693*)
			(*714*)
	P. avium		(*119*)
	P. cerasus	Fruit	(*119, 458, 487, 488, 489, 714*)
	P. domestica	do	(*487, 488, 489, 714*)
	P. persica	do	(*488, 629*)
	P. spinosa		(*642*)
	Pyrus arbutifolia	Fruit	(*584*)
	P. aucuparia (*Sorbus aucuparia*).		(*386a, 401*)
	P. malus (*Malus sylvestris*).	Fruit	(*487, 489*)
		Juice	(*693*)
	Rubus sp		(*132*)
	R. idaeus	Fruit	(*458*)
		Juice	(*119, 335*)
		Sap	(*332*)
Rubiaceae	*Coffea* sp		(*516*)
Rutaceae	*Citrus decumana* (*C. reticulata*).	Fruit	(*439*)
	Cusparia trifoliata		(*201, ref. 1*)
Santalaceae	*Leptomeria acida*	Fruit	(*591*)
Sapindaceae	*Sapindus saponaria*		(*233*)
Sapotaceae	*Achras sapota*		(*517*)
	Bassia latifolia		(*344*)
	Sideroxylon crassipedicellatum.	Fruit	(*517*)
Saxifragaceae	*Ribes* sp		(*458*)
	R. grossularia		(*792*)
	R. nigrum		(*119*)
	R. rubrum		(*209, 792*)
Scrophulariaceae	*Antirrhinum majus*		(*765*)
	Digitalis grandiflora		(*765*)
	Euphrasia officinalis		(*172*)
	Linaria cymbalaria		(*765*)
	Scrophularia nodosa		(*765*)
	Veronica officinalis		(*171*)
Solanaceae	*Cyphomandra calycina*		(*518*)
	Physalis peruviana	Fruit	(*373*)
	Solanum dulcamara	do	(*15, 776*)
	S. lycopersicum (*Lycopersicon esculentum*).		(*4*)
		Fruit	(*7, 177, 343, 693*)
	S. tuberosum	Tuber	(*167*)
Sterculiaceae	*Theobroma cacao*	Berry	(*89*)
Tiliaceae	*Tilia vulgaris*		(*201, ref. 29*)
Urticaceae	*Parietaria officinalis*		(*283*)

Family	Genus and species	Source	Reference

Tartaric Acid—Continued

Family	Genus and species	Source	Reference
Vitaceae	----------	----------	(186)
	Ampelopsis hederacea (*Parthenocissus quinquefolia*).	----------	(234)
		Leaf	(235)
	Parthenocissus quinquefolia.	Leaf	(532)
	Vitis sp	----------	(11)
		Leaf	(505)
	V. hederaceae (*Parthenocissis quinquefolia*).	----------	(798)
	V. labrusca	Juice	(413, 629)
		Fruit	(466)
	V. sylvestris	Fruit	(598)
	V. vinifera	----------	(13, 64, 216, 280, 302, 480)
		Fruit	(14, 190, 297, 326, 487, 541, 693)
		Leaf	(73, 343, 527, 645)
		Juice	(139, 214, 223, 255, 355, 528, 647)
		Sap	(374, 799, 804)
		Vine	(215, 278)
		Unripe fruit	(417, 496, 526)
		Young shoot and leaf.	(479)

Tartronic Acid

$$\begin{array}{c} \mathrm{COOH} \\ | \\ \mathrm{CHOH} \\ | \\ \mathrm{COOH} \end{array}$$

Gramineae	----------	----------	(597)

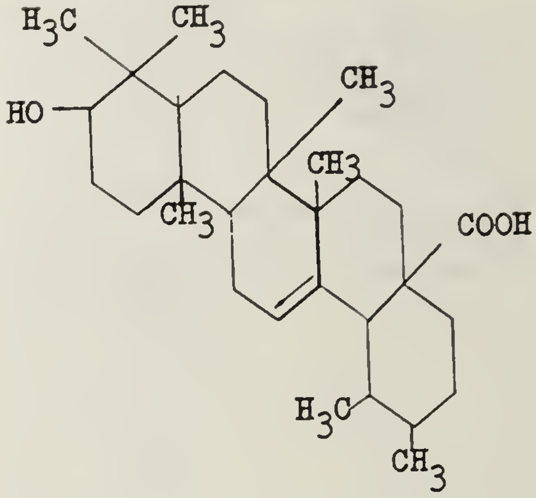
Tricarballylic Acid

$$\begin{array}{l} \mathrm{CH_2COOH} \\ | \\ \mathrm{CH\ COOH} \\ | \\ \mathrm{CH_2COOH} \end{array}$$

Aceraceae	*Acer saccharum*	Sugar sand	(398, 469)
Chenopodiaceae	*Beta vulgaris*	Evaporated juice.	(391, 402)
		Root	(392, 705)
		Juice	(395)
		Root and leaf	(742)
Gramineae	*Hordeum vulgare*	Whole plant	(474)

Family	Genus and species	Source	Reference

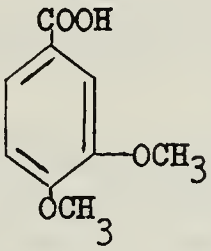
Ursolic Acid



Family	Genus and species	Source	Reference
Apocynaceae	*Allamanda cathartica*	Leaf	*(26)*
Aquifoliaceae	*Ilex aquifolium*	--------------	*(189)*
	I. latifolia	Cuticle	*(329)*
	I. paraguariensis	Leaf	*(440)*
Cornaceae	*Cornus florida*	Flower and bract	*(619)*
Ericaceae	*Arctostaphylos uva-ursi*	Leaf	*(617)*
	Enkianthus quinqueflorus	--------------	*(25)*
	Erica arborea	--------------	*(189)*
	E. carnea	--------------	*(189)*
	E. mediterranea	--------------	*(189)*
	Kalmia angustifolia	--------------	*(313)*
	Leucothoe keiskei	Leaf	*(657)*
	Rhododendron (6 spp.)	--------------	*(25)*
	R. pulchrum	Leaf	*(26)*
	R. simsii	do	*(26)*
	Vaccinium macrocarpon	Pomace	*(430)*
	V. myrtillus	--------------	*(189, 583)*
	V. oxycoccos	Fruit pulp	*(371)*
	V. vitis-idaea	--------------	*(189)*
Labiatae	*Salvia officinalis*	--------------	*(97)*
	Thymus vulgaris	--------------	*(609)*
Myrtaceae	*Psidium guajava*	Leaf	*(27)*
Punicaceae	*Punica granatum*	Peel and leaf	*(98)*
Pyrolaceae	*Pyrola minor*	--------------	*(189)*
	P. umbellata	--------------	*(189)*
Rosaceae	*Crataegus oxyacantha*	--------------	*(59)*
	Eriobotrya japonica	--------------	*(26)*
	Prunus avium	Cuticle	*(431)*
	P. serotina	--------------	*(251)*
		Leaf	*(617)*
	Pyrus communis	Fruit skin	*(428)*
	P. malus (*Malus sylvestris*).	Fruit	*(250)*
		Fruit skin	*(275, 617)*
		Fruit cuticle	*(429)*
Solanaceae	*Anthocercis intricata*	--------------	*(21)*
	A. littorea	--------------	*(21)*
	A. odgersii	--------------	*(21)*
Verbenaceae	*Verbena stricta*	--------------	*(506)*

Family	Genus and species	Source	Reference

Veratric Acid



Liliaceae	*Sabadilla officinalis*	Seed	(*441*)

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